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Cote d'Ivoire:

From Success to Failure
A Story of Growth, Specialization, and the Terms of Trade

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Abstract

Real GDP per capita and capital stock in Cote d'Ivoire grew strongly from 1960 to 1979, but have declined ever since, for twenty-five years. As a result, the country has traveled a full circle from economic success to failure in little more than a generation. What are the long-term factors behind this dismal growth story? Are the Ivorian development problems mostly of recent origin? Or there are more fundamental, economic factors that explain its long term performance?

Four principal conclusions are as follows:

First, Cote d'Ivoire's long-term growth performance is not fully explained by temporary factors (e.g., CFA overvaluation or recent conflict). Longer term factors such as capital accumulation, productivity, and terms of trade are key to understanding the country's performance as is the policy of specialization in a single commodity—cocoa.

Second, the long-term decline in per capita output started well before the currency overvaluation, and at a time of political stability, and is related to a major, secular deterioration in terms of trade that started after 1976.

Third, total factor productivity estimates indicate that TFP per capita also grew until it hit a plateau in 1976-78, and then shrank thereafter, despite gains in human capital accumulation.

Fourth, Cote d'Ivoire has pursued a policy of specialization in cocoa beans but this bet on a single commodity has ultimately failed. The strategy that brought prosperity during the 1970s resulted in a growth failure when cocoa prices began declining since 1976.

This paper— a product of the Poverty Reduction & Economic Management Unit 4 (AFTP4), Africa Poverty Reduction & Economic Management (PREM) Department—is part of a larger effort in the department to understand the sources and constraints of long-term economic growth in African countries. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at zbogetic@worldbank.org.

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Cote d'Ivoire: Growth, Conflict, Specialization, And the Terms of Trade

Real GDP per capita and capital stock in Cote d'Ivoire grew strongly from 1960 to 1979, but have declined ever since, for twenty-five years; this paper explores underlying, long-term factors of this development record. As a result, Cote d'Ivoire's real GDP per capita in 2003 is about the same as in early 1960s and the capital stock only somewhat above that in the immediate aftermath of independence.1 Poverty rate increased from 32.3 percent in 1993 to an estimated 42-44 percent in 2003 in the immediate aftermath of the conflict.2 Therefore, the country has traveled a full circle from economic success to failure in little more than a generation.

This paper aims to present some long-term stylized facts on Cote d'Ivoire's growth performance and then explore long-term factors behind that performance using deterministic and stochastic total factor productivity approaches. First, we present long-term economic and demographic trends in the 1960-2002 period and some cross-country comparisons, the macroeconomic and social impact of the 2002-03 conflict, and the key role of cocoa played in the Cote d'Ivoire's economy. Second, we discuss briefly the macroeconomic impact of the most recent 2002-03 crisis as the latest episode in a long-term economic decline that began over two decades ago. Third, we explain the crucial role of cocoa and coffee sectors, cocoa and coffee prices, and, more broadly, terms of trade, which influence both short term and long term performance of Cote d'Ivoire's economy. Finally, we present the findings of the total factor productivity analysis in order to ascertain the roles of factor accumulation and productivity movements in explaining Cote d'Ivoire's long-term growth. Annexes detail the methodologies for calculating human capital and physical capital stocks, deterministic and stochastic estimates of TFP (Annex 1), and further discussion of the role of the cocoa/coffee sector in the Ivorian and the world economy.

1. Long Term Economic and Demographic Trends

There are two distinct periods in recent economic history of Cote d'Ivoire: the "boom" period of 1960 to (about) 1979 and the period of economic decline from 1980 to 2002 (Figures 1-2). This pattern is apparent whether one looks at broad trends in the overall, per capita real output or its components, as well as population, and labor force (Table 1). GDP, consumption, and investment peaked in 1979, then fell in the early 1980s. Thereafter, the three variables recovered and began to climb, but at a slower rate

[1] Using the World Bank's SIMA database, in 2002, real GDP per capita in 1995 US dollars fell to US$776 per capita, the lowest seen since it declined to $764 in 1994. GDP per capita first broached US$800 in 1964 when it hit US$849. It thereupon faltered to $792 per head in 1965, then grew steadily to $1,376 in 1978, but declining thereafter.

[2] The World Bank (2003).

than the 1960s and early 1970s. Exports per capita did grow in real per capita terms in 1979-2002, albeit slowly. In short, most of the significant advances achieved by Cote d'Ivoire in 1960-1979 were lost in the 1980s and 1990s.

Table 1: Summary of Growth, 1960-1979 period Versus 1979-2002 period

(in percent)

Compound Average Annual Growth	**1960-1979**	**1980-2002**
Real per Capita:		
GDP, Consumption, Trade & Investment		
Output (GDP) per capita	3.92	-2.40
Household Consumption per capita	4.07	-3.03
Exports per capita	2.85	1.26
Imports per capita	5.61	-2.90
Gross Capital Formation per capita	5.61	-2.90
Population Growth	3.95	3.26
Labor Force Growth	3.46	3.28

Underpinning the per capita output decline in the second period was continued, rapid population growth. During the 1960s and 1970s, economic growth was so strong that that Cote d'Ivoire succeeded in achieving strong per capita growth in spite of rapid population growth. But in 1980-2002, continuing, if moderated population growth overwhelmed slow growth in output, resulting in drops in per capita output, consumption, imports, and gross capital formation. Having achieved a real GDP level of $1,379 per capita in 1978 (in 1995 US dollars), real output has fallen to under $776 per head in 2002, which is lower than the $849 achieved in 1964! Consumption per head fell in half from1979 to 2002. Gross capital formation (physical investment) peaked in 1978, and never recovered.

Figure 1: Output, Consumption, Exports, Imports, Investment 1960-2002

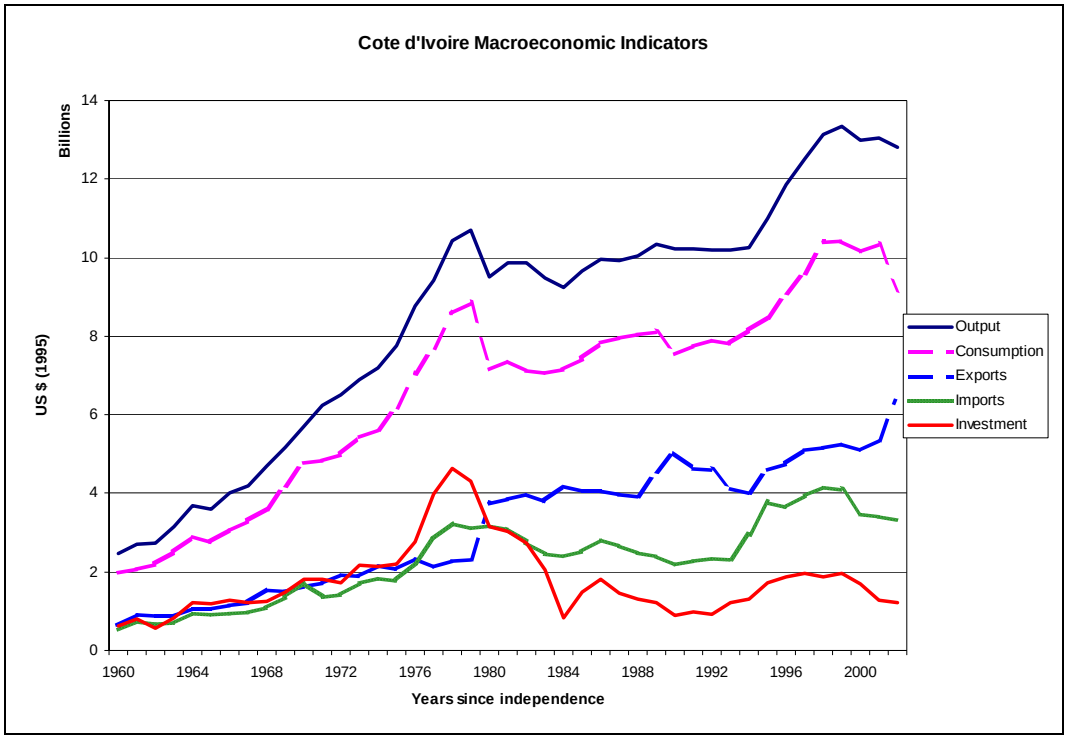


Figure 2: Per Capita Output, Consumption, Exports, Imports, Investment 1960-2002

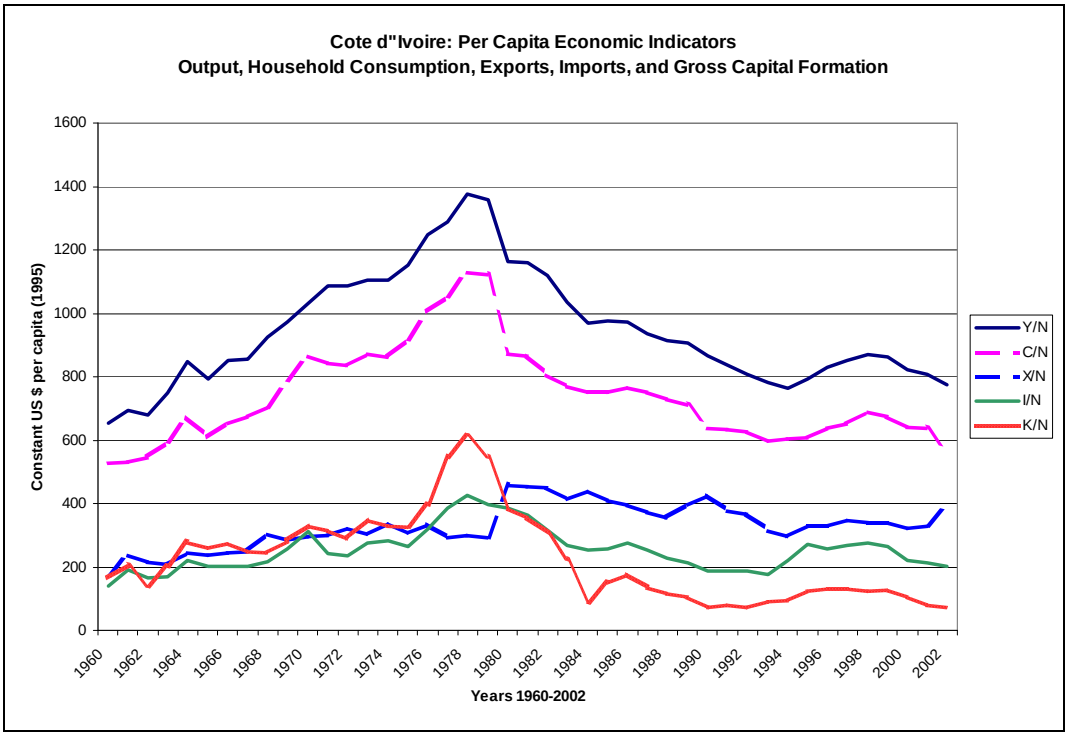
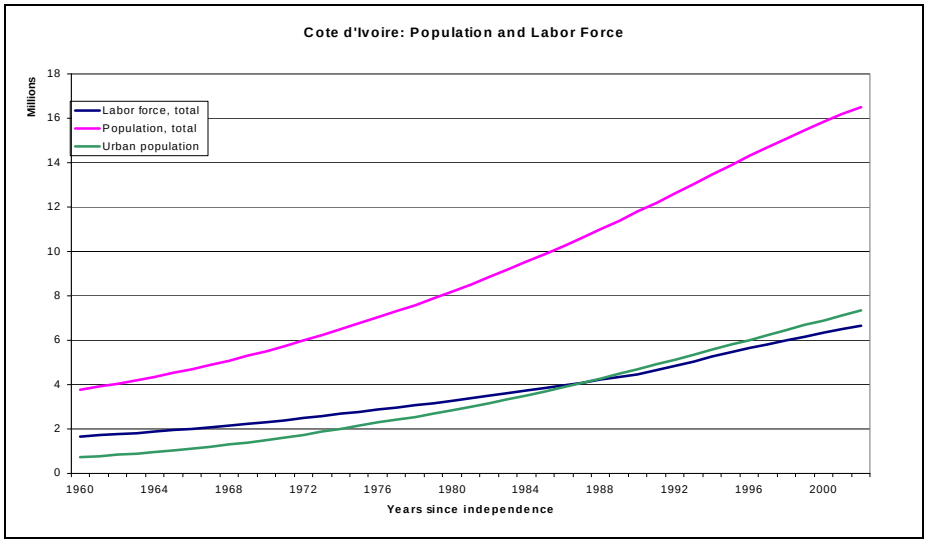


Figure 3: Population, Labor Force, Urban Population 1960-2002



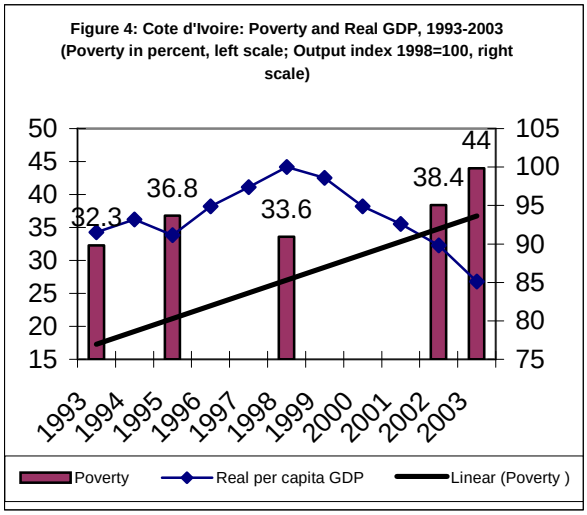
Finally, Cote d'Ivoire's growth record also compares poorly with main comparator groups of countries, suggesting that country-specific rather than regional factors are behind this performance. Using real per capita growth data for 1993-2002, we compared Cote d'Ivoire's growth with that of several other "peer groups" or benchmark sets of countries[3]. Cote d'Ivoire grew more slowly than developing countries worldwide, and slower than both sub-Saharan African countries and West African countries. Cote d'Ivoire also grew more slowly than most of the countries in the West CFA-franc zone, and slower than most countries in a set of African countries experiencing conflict during 1993-2002. Cote d'Ivoire's poor long-term growth cannot be dismissed as "typical" of either developing countries or African countries, and is not explained by the recent conflict.

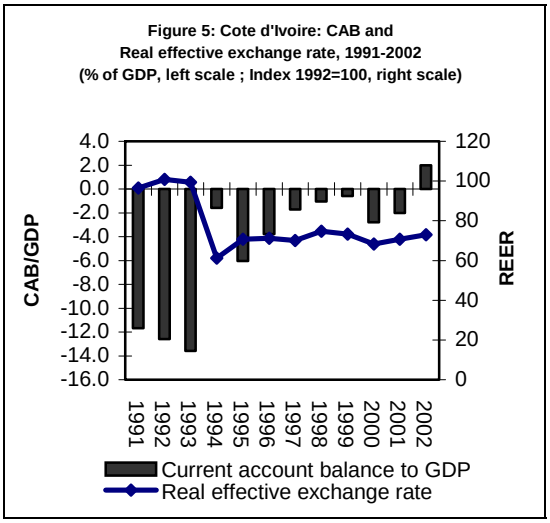
2. The Macroeconomic and Social Impact of the Crisis 2002-03

The brief 2002-03 civil conflict[4] came on top of the two decades of declining per capita real GDP and rising poverty. As such, the conflict alone does not explain the secular economic decline since late 1970s; it aggravated the already unfavourable long-term economic trends. In this section, we briefly discuss the short term impact of the crisis, focusing mainly on the social consequences. After the 1994 devaluation, which triggered gains in competitiveness and four years of rising per capita income and modest gains in poverty reduction, in 1999-2000, the Ivorian economy was almost simultaneously hit by a large terms of trade shock and political turmoil. Real per capita

[3] See the Annex for details.
[4] For details, see World Bank (2003).

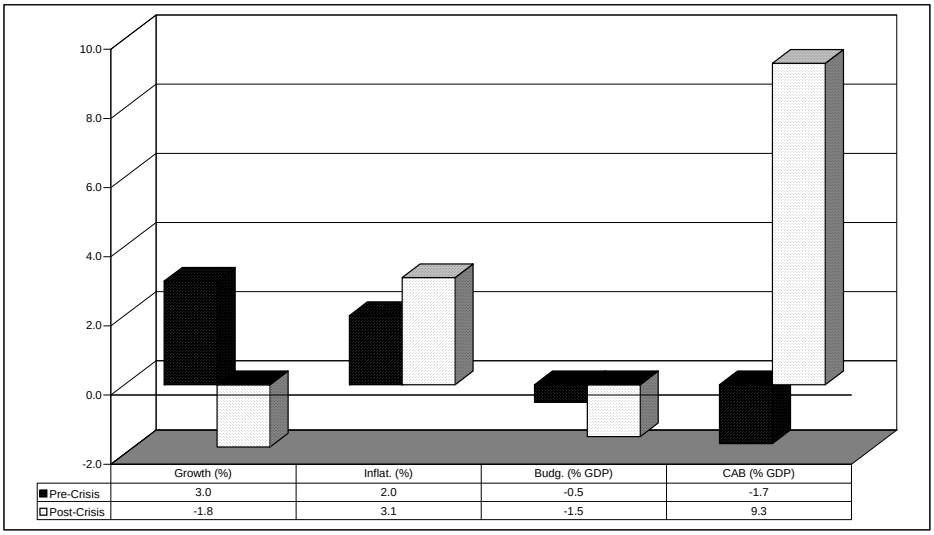
declined precipitously, reaching a cumulative loss of about 15 percent in the period 1999-2003, wiping out the post-devaluation gains on the income and poverty front. Poverty increased from 38 ½ percent in 2002 to about 42-44 at end-2003, the highest in a decade (Figures 4 and 5).





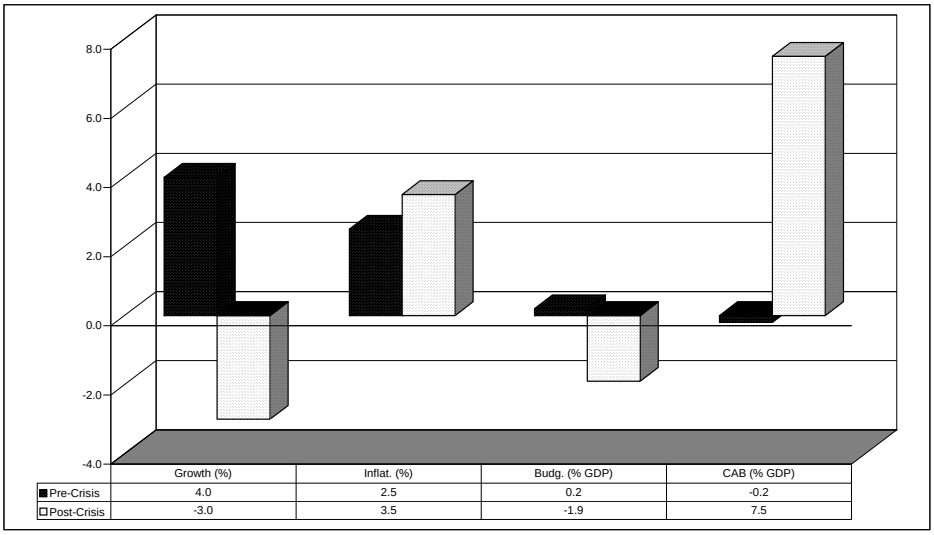
Source: World Bank staff live database, and IMF and Bank staff estimates.
Notes to Figure 1.2: The linear line is a simple linear trend of the poverty series. Poverty figure for 2003 is an estimate based on growth elasticity of poverty and the estimated number of internally displaced people (see Table 1.2 below in section on the social impact of the crisis).

Figure 6: Côte d'Ivoire - Macroeconomic Impact of the Crisis, 2002



Source: IMF and World Bank staff estimates.

Figure 7: Côte d'Ivoire - Macroeconomic Impact of the Crisis, 2003



	Growth (%)	Inflat. (%)	Budg. (% GDP)	CAB (% GDP)
■Pre-Crisis	4.0	2.5	0.2	-0.2
□Post-Crisis	-3.0	3.5	-1.9	7.5

Source: IMF and World Bank staff estimates.

While post-1994 gains in competitiveness have been largely preserved, since end-2000 there was a real appreciation of the CFA franc. (Figure 5). Since the initial overshooting after 1994, the real effective exchange rate remained relatively stable, hovering at about 30 percent below the pre-1994 level. However, since October 2000 until end 2003, there has been a real appreciation of about 20 percent. Part of the real appreciation reflects the appreciation of the euro vis-à-vis the dollar. But at the sectoral level, decline in productivity, and increased cost of production, transportation, and trade in industries located in the war affected areas indicate loss of competitiveness. Part of the regional trade and transshipment has been diverted to neighboring countries (e.g., Ghana).

The Social Impact

The social situation before the outbreak of the civil war in September 2002 had already been very difficult, as reflected in dramatic deterioration in the U.N. Human Development Index (HDI) and per capita income rank in recent years. Even before the 2002-03 crisis, Côte d'Ivoire experienced a major deterioration in social indicators and difficulties in meeting the Millennium Development Goals (MDGs). According to the 2003 UN Human Development report, life expectancy was lower and infant mortality higher in 2001 compared with 1995, despite strong growth in the 1995-98 period. After temporarily declining in 1998, poverty rate is estimated to have exceeded in 2002 its 1995 level—about 38 ½ percent of the population—erasing the gains in the post-devaluation years.[5] According to the latest UNDP HDI, Côte d'Ivoire was ranked 161 among 173 countries, *16 ranks lower than in 1995*; its income rank in PPP terms was 148, reflecting an equally dramatic decline from the rank of 130 in 1995. The highly unequal income distribution, measured by the Gini coefficient, is likely to

[5] Institut National de la Statistique (2002). *Profil de Pauvreté en Côte d'Ivoire en 2002*, Abidjan (Auguste).

have worsened. Progress towards achieving five out of seven MDGs—those relating to primary education, gender equality, and health—ran far behind schedule (Table 2).

Table 2: Côte d'Ivoire: Progress Towards Key Millennium Development Goals, 2001

Selected Goals and indicators	1990	1995	2000-01	Assessment of Progress
Goal 1: Halve the proportion of people suffering from hunger				
Indicator: Undernourished (% of population)	18%	N.A.	15%[2/]	On track[1/]
Goal 2: Ensure all children complete primary education				
Indicators:				
Net primary enrollment ratio	47%	53%	64%	Far behind
Children reaching grade 5	73%	75%	91%[3/]	On track [1/]
Goal 3: Eliminate gender disparity in all levels of education				
Indicators:				
Female net primary enrollment ratio as % of male ratio	N.A.	N.A.	75%	Far behind
Female net secondary enrollment ratio as % of male ratio	N.A.	N.A.	N.A.	Far behind
Goal 4: Reduce under-5 and infant mortality rates by two thirds				
Indicator: Under-5 mortality rate (per 1,000 live births)	155	165	175	Slipping back
Goal 5: Improve maternal health				
Indicator: Reduce by three quarters maternal mortality ratio by 2015	N.A.	1,200	N.A.	Behind
Goal 6: Combat HIV/AIDS, malaria and other diseases				
Indicator: Adults (% age 15-49) living with HIV/AIDS	N.A.	9.8[4/]	9.7%	Behind
Goal 7: Halve the proportion of people without access to better water sources				
Indicator: Population without sustainable access to improved water sources	20%	N.A.	19%	Behind[2/]

Source: Human Development Report, 2003, UNDP; extracted from the country tables. The table summarizes analysis of progress towards goals for 2015 based on linear interpolation of trends in the 1990s.

[1/] Following the impact of the 2002-03 crisis, the assessment of these two indicators has most likely worsened.

[2/] 1998-2000.

[3/] 1999-2000.

[4/] 1994.

The 2002-03 crisis worsened the social situation in a very short period of time, resulting in a full-fledged social and humanitarian crisis. Between 500 and 1,000 persons were killed and about 1.2 million people—about 6 percent of the population—became internally displaced (IDPs) or sought refuge in neighboring countries. Of this number, about 800,000 were internally displaced, and the remaining 400,000 left for neighboring countries.[6] An estimated 500-700,000 children left school and many schools and medical services effectively stopped operating, in part because of the departure of civil servants and the breakdown of the central administration in the areas controlled by ex-rebels. An estimated 20,000 people were rendered homeless in Abidjan as a result of the government's destruction of shantytowns (*quartiers précaires*), which were adjacent

[6] U.N. Report to the Secretary-General, Mission of the Humanitarian Envoy for the crisis in Côte d'Ivoire, 12 January-12 February 2003.

to military and other sensitive areas,[7] under the campaign to fight "the infiltration of the rebels." As a result, by end-2002 poverty rate likely increased by an estimated 4 percentage points to about 42 ½ percent of the population; with further increase in displaced/refugee population, it is likely to have increased by an additional 1 ½ percentage points in early 2003 (Table 3). In rural areas, poverty rose because of the loss of farmers' crop incomes; in urban areas, unemployment and poverty rose due to closures of a number of large companies (e.g., SITARAIL for example at the beginning of the crisis; but the rail line was later reopened following an agreement on reopening of the border between Burkina Faso and Cote d'Ivoire) and dwindling activity in industry (e.g., textiles), transport and domestic trade.

Table 3: Côte d'Ivoire - The Social Impact of the Côte d'Ivoire Crisis, 2002-03

	1995	2002			2003		
		Pre-crisis	Post-crisis		Pre-crisis	Post-crisis	
		(annual percent changes; unless otherwise indicated)					
GDP	7.1	3.0	-1.8		4.0	-3.0	
GDP per capita	3.2	-0.3	-4.5		0.7	-6.3	
Inflation (Annual average)	14.1	3.0	3.9		2.5	4.0	
Poverty rate (percent of the population)	36.8	38.4	42.5	1/	39.5	44.0	1/
Gini coefficient	0.37	0.37	0.40	2/	0.37	0.44	2/
Human development index							
Rank among 173 countries	145	161	164	3/	164	165	3/
Internally Displaced Persons (IDPs) and refugees (millions)	…	0	1.0	4/	0	1.2	4/

Source: IMF (growth, inflation); World Bank (social indicators); U.N. (human development index).
1/ Poverty rate for 2002 was reported in the results of the NSI 2002 household survey *Profile de Pauvrete en Côte d'Ivoire en 2002* (page 8). For 2003, it was calculated based on the past elasticity of poverty rate with respect to per capita growth and the additional poor attributable to the Internally Displaced Persons (IDPs) and refugees to neighboring countries.
2/ Gini coefficients for 2002-03 were calculated as linear extrapolation based on changes in poverty rates.
3/ The rank of the HDI for pre-crisis 2002 relates to 2001; ranks for post-crisis 2002, and 2003 were extrapolated based on the changes in the real GDP per capita and the additional, estimated impact of the 2002-03 crisis on the number of internally displaced people and the refugees.
4/ Based on the data of U.N. Office for the Coordination of Humanitarian Affairs.

The adverse regional impact on the poor—mostly in rural areas— has varied from moderate in the south and south-east to severe in the north and, particularly, the west.[8] In the south and south-east, where farming was least affected by the conflict, cocoa farmers also benefited from higher cocoa prices and the successful exports of most of their production. Coffee producers, particularly in the west, have suffered from low international prices, inability to collect their entire crop because of the lack of security,

[7] A relocation operation of these displaced persons has been formulated through the World Bank supported PACOM project.
[8] These preliminary assessments are based on the estimated impact on farmers' income from main crops and the impact on displacement of farm labor, using past households surveys and existing monitoring systems.

increased local marketing margins, and the cost of roadblocks. Roadblocks alone may have added up to CFAF50/kg, about 25 percent to "normal" farm-gate prices. In the Savannah region, the social situation is probably critical: at least 30 percent of cotton production was estimated to have been lost, resulting in significant losses of incomes and a sharp rise of poverty in what is already the poorest region of the country.

The composition of priority public expenditures[9] shifted away from education, health and social spending, towards military, security, and humanitarian expenditures. In particular, the combined share of education, health and economic infrastructure in 2002 was budgeted at 50 percent of total priority expenditures, but the actual share was only 42 percent; reported defense spending raised its share from 8.7 to almost 10 percent. The most pro-poor public social expenditures—on primary education and basic health—may have suffered disproportionately, and the incidence of HIV/AIDS is on the rise. The latest information suggest the incidence of HIV is much higher rate in the war affected regions (about 20) percent than previously reported (12 percent). The risk of other major diseases (malaria, cholera, and yellow fever) increased.

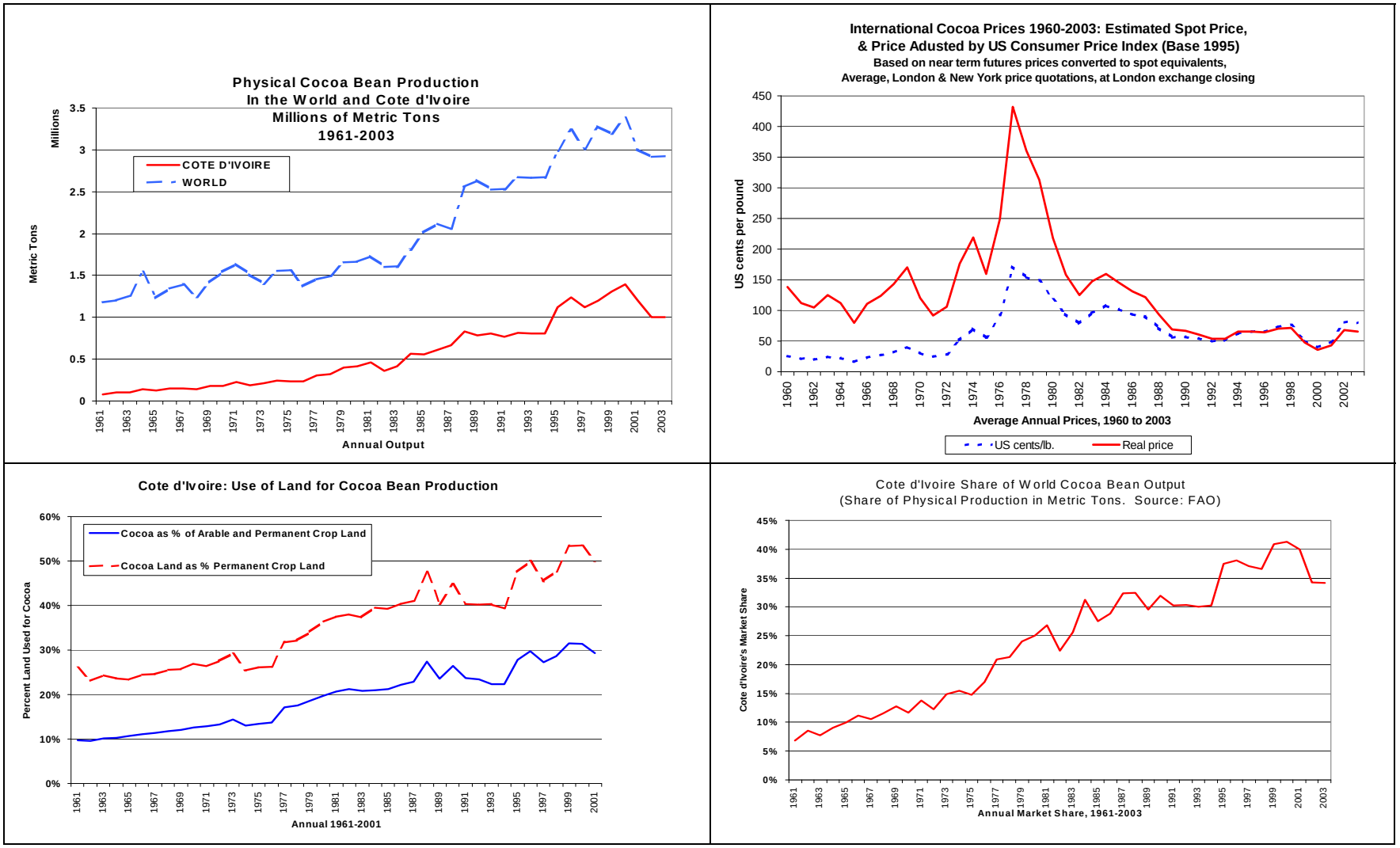
Social and institutional infrastructure (e.g., schools, clinics, and local government institutions and agencies), especially in poor rural areas, has suffered more than the traditional economic infrastructure (e.g., transportation networks, water and electricity). Numerous schools and local medical facilities have been reportedly abandoned and/or looted, and the qualified local government cadre has left the most affected regions. Major economic infrastructure (e.g., roads, rail, ports, water, and electricity) have not suffered from extensive war-related damage, but there is little doubt that its productivity has declined as operations and maintenance and critical repair was postponed, requiring more costly operating and capital repair later on. Despite reduced receipts and arrears from Ghana, the power sector has so far withstood the crisis.

3. The Role of Cocoa in Cote d'Ivoire's Economy

Over the last forty years, cocoa output has grown to dominate Cote' d'Ivoire's economy and world production (Figure 8). First, Cote d'Ivoire's output has grown from low levels to as much as 1.4 million tons in 2001, equivalent to about 40 percent of world's output. Second, the nominal and real cocoa prices on world markets generally rose until it hit an all-time high in 1976, then collapsed and have never fully recovered. Third, the share of agricultural land that Cote d'Ivoire devoted to cocoa production increased steadily.

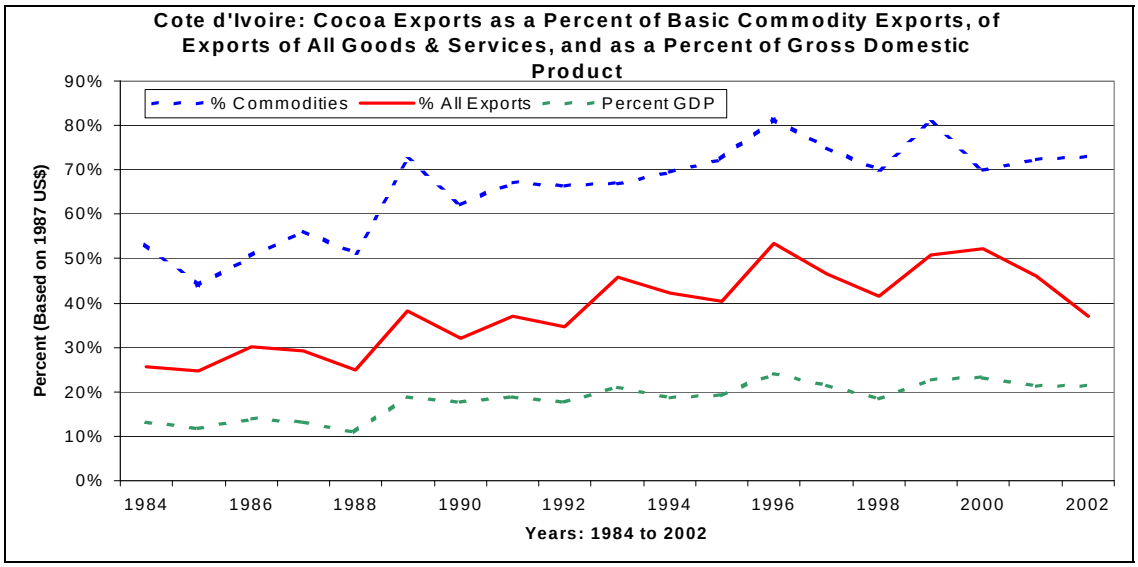
[9] Priority expenditures include spending on education, health, economic infrastructure, mines and energy, agriculture, interior, defense and justice.

Figure 8: World & Cote d'Ivoire Cocoa Production, World Prices, Cocoa Land Use in Cote' d'Ivoire, and Share of World Market



Cocoa exports now dominate Cote d'Ivoire's trade and economy. The importance of cocoa exports in Cote d'Ivoire's trade and economy increased significantly (Figure 9). By 2000, raw cocoa represented 80 percent of the country's commodity exports, over 50 percent of all exported goods and services, and 21 percent of GDP. Considering that several other sectors are also cocoa-related, it is clear that the country has become very dependent upon one raw commodity, cocoa.

Figure 9: Cocoa Exports as a Percentage of Commodity Exports, All Exports (Including Services), and Gross Domestic Product



Commodity price declines since 1977 have undermined the benefits of growth in Cote d'Ivoire's physical cocoa output. The two periods in Cote d'Ivoire's growth history exactly coincide with the price profiles on world commodity markets. (Table 2). Real prices for raw cocoa, cotton and coffee increased on world commodity markets from 1960 until they hit all-time highs in 1977. After 1977 real prices crashed, and on average have declined steadily ever since. Since 1977, cocoa price declines have greatly exceeded production increases. The results for cocoa are reinforced by developments in coffee and cotton during 1977-2003. Coffee production has not increased, while real prices declined. Cotton output increased, but real prices fell. Simply put, raw commodity production in general and cocoa production in particular have been very low rate-of-return investments for Cote d'Ivoire. Consequently, the strategy of specialization in cocoa has not been successful.

Since Cote d'Ivoire as the world's leading cocoa producer has certain market power, the world price trend is not entirely exogenous.[10] Regression estimates provide evidence that Cote d'Ivoire's cocoa production (quantity) impacts world prices, and that a

[10] To test the hypothesis that Cote d'Ivoire is indeed a price-maker in the world market for cocoa, we estimated the world cocoa price elasticity with respect to Cote d'Ivoire production quantity (in metric tons) an efficient fully modified least squares estimator (FM-OLS) (Phillips and Hansen (1990), Hansen (1996) and Gregory and Hansen (1996)). For details, see Bogetic, Espina, and Noer (2004).

structural break occurred in the market in about 1975, the year in which Cote d'Ivoire's share of world output rose to 15 percent (Table 4).

Table 4: Cocoa, Coffee and Cotton Market Performance Summary, Real World Price Trends versus Physical Production in Cote d'Ivoire

Compound Average Annual Growth Rates For 1961-1977, 1977-2003, and 1961-2003 - Raw Commodities: Cocoa, Coffee & Cotton Tonnage Produced in Cote d'Ivoire Versus Inflation Adjusted Prices on World Markets			
	1961-1977	1977-2003	1961-2003
COCOA BEANS			
Production Growth (Metric Tons)	+8.61%	+4.69%	+6.17%
Real World Price Trend	+8.80%	-8.88%	-1.28%
COFFEE BEANS			
Production Growth (Metric Tons)	+2.86%	-2.28%	-0.34%
Real World Price Trend	+6.77%	-4.61%	-3.21%
COTTON LINT			
Production Growth (Metric Tons)	+19.93%	+6.34%	+11.33%
Real World Price Trend	+1.18%	-4.61%	-2.47%
Sources: Commodity production quantity data is from the FAO, and world prices in US dollars from commodity exchanges are provided by the IMF. The US CPI is used to adjust for inflation.			

4. Capital, Labor, And Total Factor Productivity

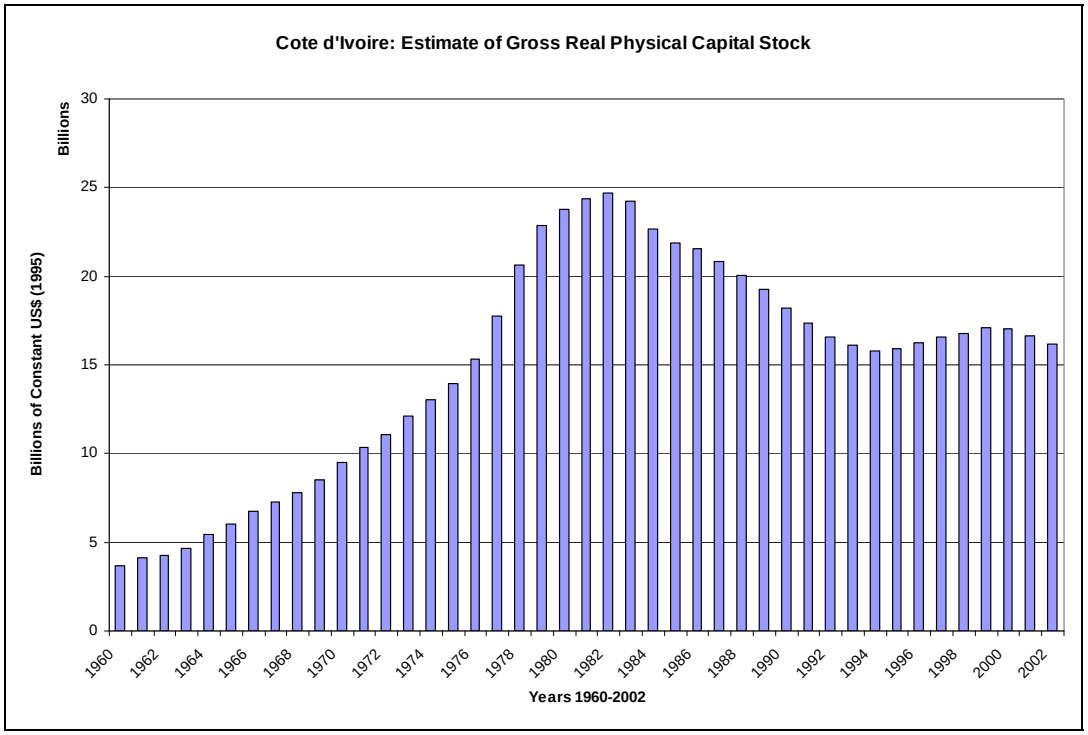
The following estimates of the capital stock, human capital, and output per worker are hoped to shed light on the underlying, long-term factors behind Cote d'Ivoire's growth performance. We begin by discussing the evolution of the capital stock and then an estimate of the educational attainment of the labor force.

Physical Capital Stock

Since 1982, Cote d'Ivoire's capital stock has declined with the short-lived exception of the immediate post-devaluation years (1995-99). Capital stocks are known to be difficult to measure, flows less so. Our estimate of the capital stock uses the conventional "perpetual inventory method" based on gross capital formation, an initial capital stock and a depreciation rate of 10 percent[11] (Figure 10). According to our estimate, after 1979, the increase in the real capital stock of the entire economy slowed dramatically and since 1982 actually declined, and never recovered.

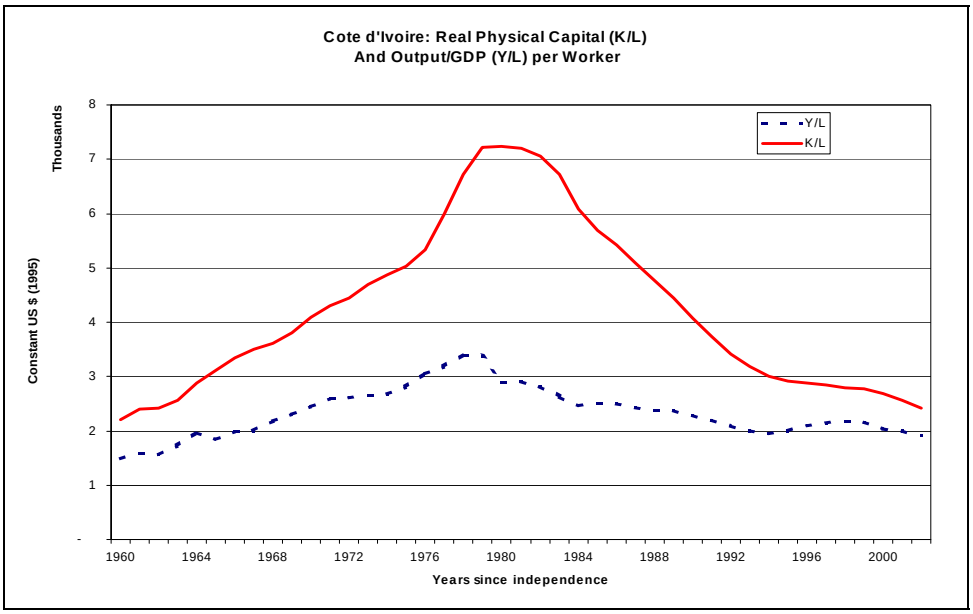
[11] For details of the estimate and the sensitivity to initial capital stock and depreciation assumptions, see Annex 1.

Figure 10: Estimate of Physical Capital Stock, 1960-2002



***Per capita* capital stock has also declined dramatically over the past two decades** (Figure 11). According to these estimates, per capita real output and physical capital grew strongly until 1979, then fell precipitously. From a peak of over $7,000 per worker, capital stock fell to about $2,500 per worker in 2002, estimated in 1995 dollars. Real output per worker fell from a peak of nearly $3,400 to only $2,000 in the same period.

Figure 11: Per Capita Output and Physical Capital Stock, 1960-2002

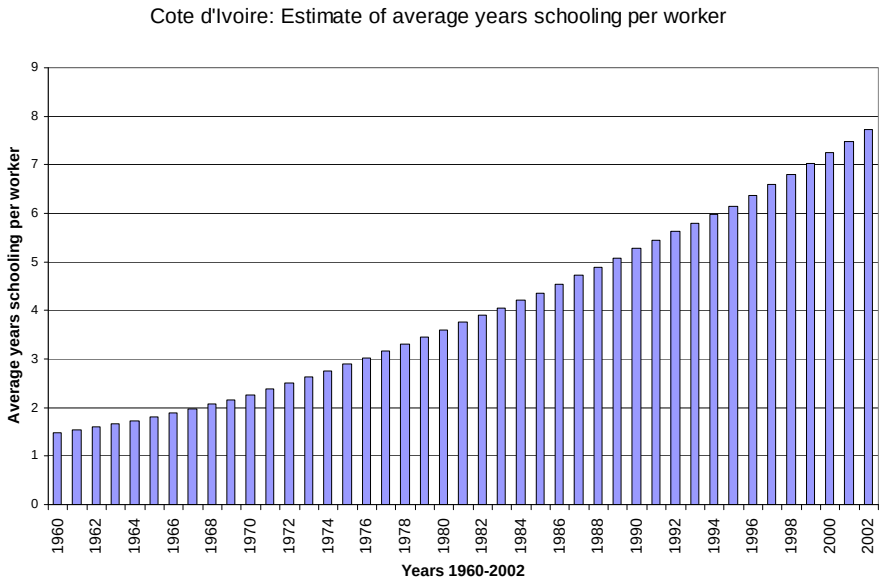


Human Capital

Educational attainment is clearly associated with human capital, and is used in the literature as a proxy for human capital or "labor force quality". This indicator is commonly used to measure "human capital" or "effective labor force."

Human capital, as measured by educational attainment, has risen in Cote d'Ivoire since independence (Figure 12). This is evidenced by an estimate[12] of the average years of schooling per worker for the period 1960 to 2002[13]. Since most educated persons work, most youth entering the labor force are educated, and as average years of schooling for those who do attend school is rising, the estimated average schooling of workers rises much faster than the basic literacy rate for the entire population. One important caveat: this estimate does not take into account the likely impact of AIDS on human capital, which has been particularly important since mid-1980s.

Figure 12: Estimate, Average Years in School Per Worker, Cote d'Ivoire, 1960-2002



[12] This "labor quality" estimate is described in detail in the Annex, and permits us to estimate total factor productivity in the next section.

[13] Comprehensive data on educational attainment is lacking for Cote d'Ivoire. The best readily available measure of educational attainment in terms of completeness over time is the literacy rate, as measured in surveys as reported by the United Nations. For the entire population over 15 years, the literacy rate climbed from 21% in 1970 to about 48% in 2000. For youth, the rate rose from 33% in 1970 to about 60% in 2000. See further explanations in the Annex.

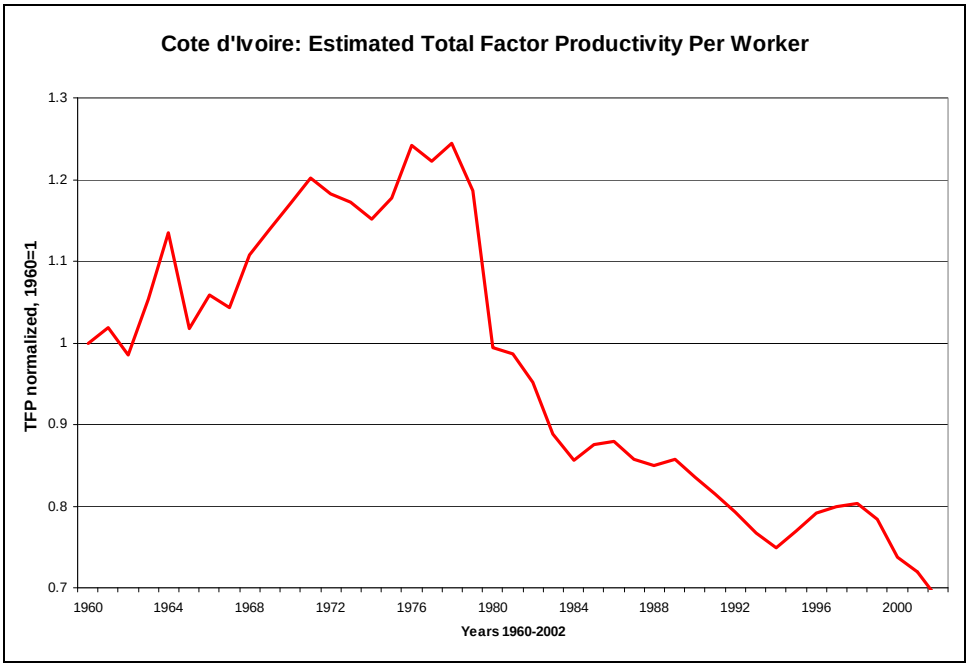
Total Factor Productivity (TFP)

We present here both deterministic and stochastic estimates of TFP. First we discuss the results of a "deterministic" or "accounting" approach to TFP. Then we present results of a productivity regression which estimates these parameters. Considerable detail is relegated to the Annex 1.

Deterministic Accounting Estimate of TFP

One conventional approach, first followed here, is to use national income data and other information with assumed parameter values, and simply compute estimates of TFP in a deterministic fashion.[14] Our TFP accounting estimate is presented in Figure 13[15]. The rate of growth of capital stock per worker is derived from the estimates of capital stock, and the growth in human capital from the increase in average schooling discussed in the earlier section.

Figure 13: Estimate of Total Productivity Per Worker, 1960-2002



Total Factor Productivity (TFP) grew until about 1978, then declined substantially thereafter. This estimate shows TFP per worker in Cote d'Ivoire to have risen from 1960 until 1979, then to have turned around and declined thereafter. By 2002 TFP per worker

[14] See Mahajan (2003). We provide a comparison between out estimates and these other estimates in the Annex 1.

[15] The approach described in detail in the Annex 1 is used to compute the contributions of the growth rate of physical capital per worker and changes in average schooling to the growth rate of output per worker. In the base year, TFP is normalized by assuming that it equals unity. Then, one computes the levels by computing the cross products from t = 0 to time period t of one plus the rates of growth for time periods zero to t.

had fallen steadily by 50 percentage points since 1979, and TFP was lower than it had been in 1960 (off 30 percentage points). Alarmingly, TFP has trended downward strongly since 1998, boding ill for the future. Depending upon how one chooses to interpret TFP, Cote d'Ivoire is experiencing negative technological progress, or negative gains in efficiency over time. The value added above and beyond the contributions of physical and human capital appears to be shrinking.[16]

According to this estimate, the steady decline in output per worker in the Cote d'Ivoire in the 1980s and 1990s is not just a result of falling capital stock per worker. It also appears to be a result of falling total factor *productivity* per worker.

Stochastic Regression Model of Factor Productivity

An alternative approach, a stochastic regression model of factor productivity (which estimates parameter values) is also used to evaluate the validity of the deterministic TFP analysis in the last section.[17] The results were satisfactory, especially when on considers that the sample is small, the main explanatory variables were estimates that we constructed, and that many analysts had major difficulties with the data on countries from Sub-Saharan Africa.[18] We ran a multivariate, Cobb-Douglas style "factor" model of productivity, which uses our estimate of capital stock per worker and adds a term for human capital, in this case a term representing our estimate of average schooling per worker. The coefficient point estimates for physical capital and labor are close to what is expected[19]. While the estimate for physical capital seems robust and precise, the human capital coefficient estimate has a wide confidence interval and low T-statistic.

The terms of trade appear to account for at least part of the decline in TFP. The concept of "Solow-residual" TFP is not directly observable; there is no times series of direct observations to rely upon. For regression analysis, economists have traditionally used proxy variables or instrumental variables. But, in Cote d'Ivoire specifically and (and in some other developing countries[20]), TFP growth over time is not a simple quasi-linear trend. Proxies or instruments must be carefully selected. We noted during the analysis that the TPF measured by the accounting (i.e., deterministic) method had a time profile rather similar to the time profile of the terms of trade. In this context, if world prices for commodity exports increase, the resulting additional value added contributes to the "residual", TFP. If, on the other hand, prices of imported production inputs increase, the

[16] Note that if we are overestimating the contribution of either factor, for example overestimating human capital by overestimating schooling or "worker quality", the net result would be to underestimate TFP.
[17] See Bosworth & Collins (2003), Cohen & Sots (2001), and Ghosh & Kraay (2000)
[18] For example, Bosworth and Collins (2003) did not extend their global TFP estimates to Africa in their paper "The Empirics of Growth: An Update", September 22, 2003.
[19] See the Annex 1 for a detailed analysis of expected parameter estimation results. The schooling coefficient point estimate comes in at $\mathbf{b_2} = 0.0553$, not far from the "ballpark" expected value of 0.079 (which we would revise downward anyway if we accept the proposition that Cote d'Ivoire has a high MPK and hence $\mathbf{a} > 0.35$).
[20] See for example Bosworth and Collins (2003), specifically the graphs in second page of the Appendix.

residual value added is reduced. That is, for a small trading economy, the terms of trade affects the value added of production.[21]

Table 5: Regression Estimation Results of a Factor Productivity Model for the Cote d'Ivoire, 1960-2002

Dependent Variable: First Differences of Natural Logarithms of Real Output per Worker

Indépendant Variables	Coefficient	T-Statistic
Delta Log, Capital per Worker	0.56473	4.31
Delta, Average Schooling per Worker	0.05528	0.32
Delta Log Terms of Trade	0.10019	2.77
Constant	- 0.00465	0,17

Durbin-Watson Statistic: 1.9607 R-Squared: 0.52 F(5,36) = 13.5
ADF test on residual: Z(t) = -6.153 > 1% Critical Value

A one percent change in the rate of change in terms of trade results in a one-tenth of a percent change in the measured real value of per capita output. Table 5 presents the coefficient estimates, measures of "goodness of fit", and tests of certain hypotheses about parameter values, for a regression "explaining" the rate of growth of output per worker as a result of the growth rate of physical capital per worker, the increase of average schooling per worker (representing growth in human capital), and the rate of change of the terms of trade.[22] The rate of change of the terms of trade is taken as an important determinant of or proxy for Total Factor Productivity[23]. A one percent change in the rate of change in terms of trade results in a one-tenth of a percent change in the measured real value of per capita output. A dummy variable added for the internal conflict in 2000-2002 provided an estimate that conflict knocked -3.8% off the expected growth rates for those three years, for a cumulative effect of 11% for the three years.

5. Concluding Remarks

The preceding analysis suggests several conclusions, an important policy implication for diversification, and some avenues for further research on Cote d'Ivoire's economy.

First, Cote d'Ivoire's long-term per capita growth performance is not fully explained by either the over-valuation of the CFA in late 1980s and early 1990s, nor by the recent conflict. While the impact of the conflict was severe—especially on the social front—longer term factors such as capital accumulation, total factor productivity, and terms of trade are key to understanding the country's performance over these four

[21] For a trading nation, the prices of exports and imported inputs already appear in the national income accounting statistics used to compute TFP. In the Annex 1, we first present an intuitive explanation, and then an algebraic manipulation of national income identities to show the link between the terms of trade and TFP.

[22] The coefficient point estimates for the contributions of physical capital and human capital (schooling) differ somewhat but not significantly from the values often assumed in the literature, and from those which were assumed in the accounting TPF estimate presented earlier.

decades as is, in part, the choice of development policy in the early 1970s and earlier to *specialize* in cocoa and massively expand cocoa bean production. This is notwithstanding the facts that part of this specialization was an endogenous response of cocoa farmers to high international prices and that some diversification did occur with the development of light manufacturing and food processing.

Second, the long-term decline in per capita output is related to the secular deterioration in terms of trade. The per capita decline in output started well *before* the pronounced currency overvaluation, and at a time of political stability. It is related to a major deterioration in terms of trade that started after 1976.

Third, total factor productivity estimates indicate that TFP per capita grew until it hit a plateau in 1976-78, and then shrank thereafter despite gains in human capital accumulation. A Cobb-Douglas productivity regression validates the accounting TFP estimate and provides evidence for a major turnaround and subsequent, secular deterioration in the terms of trade, which partly explains the decline in per capita output and falling TFP.

Fourth, reflecting partly a strategic choice of development policy in the 1970s, Cote d'Ivoire has become heavily specialized in cocoa bean production and its exports, and has steadily increased physical cocoa output. This strategy brought prosperity during the 1970s when real cocoa prices rose, but turned for the worse when cocoa prices dropped steadily after 1976 presaging the long-term economic decline since 1978-80. (empirically, Cote d'Ivoire began to exercise market power on the world price of cocoa in 1975 when its share of world output increased beyond [15 percent].). Worse, coffee and cotton prices—two other major export commodities—exhibit the same profile. A related long-term trend reinforcing the terms of trade impact was the depreciation of the U.S. dollar vis-à-vis the French franc since the 1985 Plaza Accord. As a result, the government's strategy of cocoa specialization has been defeated by cocoa and other commodity price trends. In short, the bet on a single raw commodity to finance development efforts failed. The dependence upon cocoa seems to be at least one important explanatory factor for Cote d'Ivoire's growth profile and particularly the post-1980 decline.[24]

Looking forward, Cote d'Ivoire faces twin challenge for development policy of both short-term (restoring stability on political and security fronts) and long-term nature (restarting structural reforms). While ending the conflict is important for short-term economic recovery and political stabilization, it is only a first step towards sustainable recovery. Improving governance at all levels, restructuring and diversifying the economy for more balanced, long-term growth will be critical in reversing the long-term economic trends of the past two and a half decades.

24 This points to at least two areas for further analysis: (i) volatility: the extent to which commodity-related volatility has impacted growth in Cote d'Ivoire,24 and (ii) competitiveness: Cote d'Ivoire's competitiveness and real effective exchange rate, issues dealt with in two separate background papers to the Cote d'Ivoire's Development Policy Review.

Diversification opportunities should be identified and pursued vigorously. Cocoa takes seven years to become commercially productive after initial planting, and has a useful life of three to four decades. The investment in productive cocoa acreage represents sunk costs, and it may not pay to uproot and replant with another crop. But cocoa first planted in the 1960s and 1970s may be nearing the end of its useful life. Therefore, studies on agricultural, technological, and financing aspects of the feasibility of using some of the land for planting some other crop or economic activity with higher value added potential, rather than replanted with cocoa, may be timely. Such studies may also help Cote d'Ivoire to develop a timely diversification strategy and action plan leading to actual diversification while avoiding re-investment expenses. Given its global market power, Cote d'Ivoire's reduction in cocoa output may help raise cocoa prices somewhat, thereby raising returns on the remaining acreage. Studies of the feasibility of replacing cocoa acreage on an orderly basis, and developing a broader diversification strategy, and an implementation plan, might contribute to a less specialized and more robust economy.

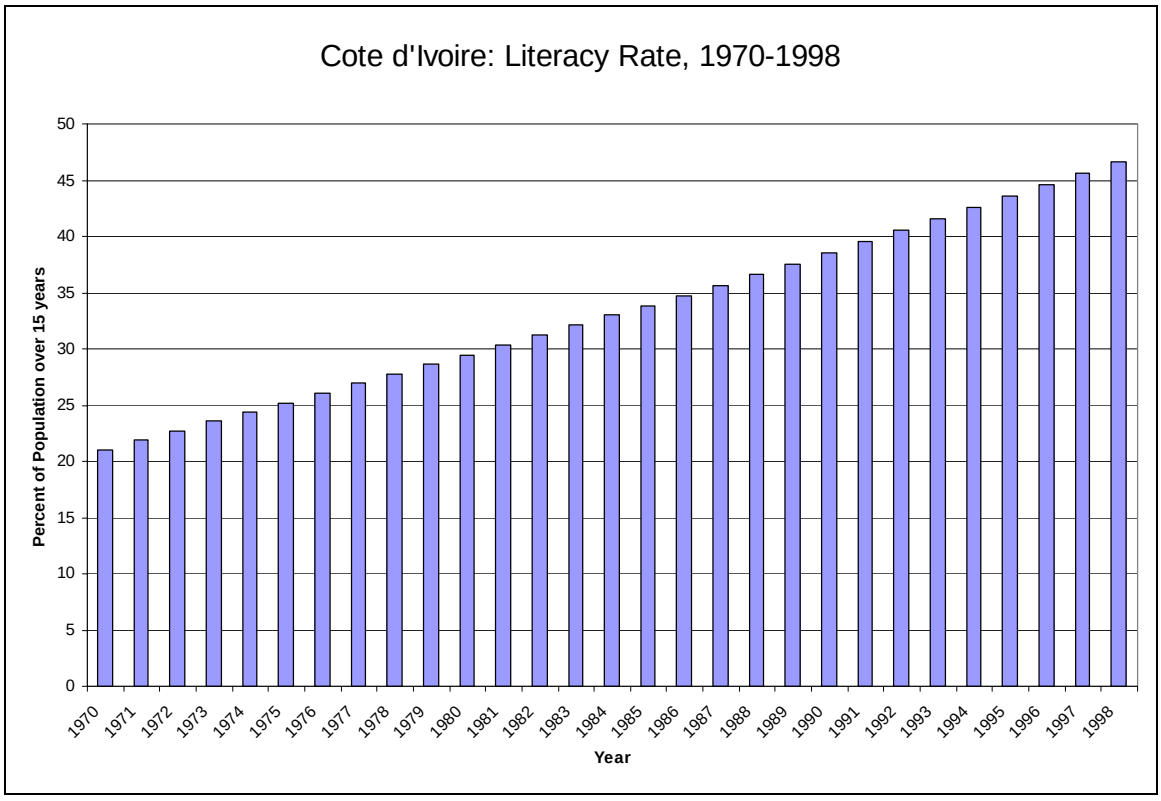
ANNEX ONE: Methodological Notes

This annex provides detail on the estimates of human and physical capital underlying the total factor productivity analysis, as well as further detail on the TFP analysis.

Estimating the Average Schooling of Workers

Figure A-1 shows annual estimated literacy rates from SIMA for Cote d'Ivoire for 1970 through 1998, for the entire adult population aged15 years and older.

Figure A-1: Adult Literacy Rate in the Cote d'Ivoire, 1970 to 1998



Below we provide step-by-step detail on our procedure for estimating the average years of schooling per worker in Cote d'Ivoire.

- First, the adult literacy rate for 1970 through 1998, available in the Bank's SIMA database (new Development Data Base—DDP), was extrapolated back to 1960 based on the 1970-1980 rate of increase, and forward to 2002 based on the 1988-1998 rate.

- We then calculated the total number of adults in the population by subtracting the number of children 14 years old and under from the total population; both series are found in the Bank's SIMA (current DDP database).

- Next, we estimated the rate at which literate adults participate in the labor force. The assumed "literate labor force participation rate" is very high, but trending down somewhat as literacy increases. The assumption is that there is career training specialization in Cote d'Ivoire. In the largely rural environment, persons planning to remain engaged in the within-household production typically do not invest in an education and hence often remain illiterate while persons planning to participate in the formal labor force seek education.

- This allowed us to estimate the literacy rate among workers. Due to the low but rising literacy rate in the population, and the high proclivity among the educated to participate in the labor force, the labor force is much more literate than the general population of adults.

- We estimated the average number of years in school or average educational attainment for literate persons. The regular social surveys of Cote d'Ivoire ask this question of a fairly large sample of respondents. In 2002, for example, the average schooling per worker was 7.7 years, higher in urban areas and in industry, lower in rural areas and in agriculture. There is also some information as to how long students stay in school, conditional upon whether or not they enroll in the first place

- The average schooling per worker in the labor force is the product of the estimated labor force literacy rate times the estimated average schooling of those who are literate.

The accompanying table A-2 below provides the data and estimates used. The estimated average schooling per worker developed here is higher than those typically encountered in the literature (for example, Pradeep Mahajan (2003), Bosworth & Collins (2003) or Cohen & Soto (2001)). Some authors do not provide estimates for Cote d'Ivoire (e.g. Barro et al) while others cite problems with the data from Sub-Saharan Africa. Some seem to rely on the literacy rate of the general population as a proxy for educational attainment of the work force.

Table A-1: Details of the Estimation of Average Schooling per Worker in Cote d'Ivoire

Year	Labor Force	Adult % Literate	Adult Population	Literate Participation	Working Literates	Worker Literacy	Schooling If Literate	Schooling Per Worker
1960	1,661,248	15.3	2,114,981	95.0%	306,849	18.5%	8.00	1.48
1961	1,711,845	15.8	2,174,059	94.9%	325,146	19.0%	8.09	1.54
1962	1,765,456	16.3	2,238,940	94.7%	345,174	19.6%	8.18	1.60
1963	1,822,394	16.8	2,308,487	94.6%	366,868	20.1%	8.27	1.66
1964	1,882,216	17.4	2,383,550	94.4%	390,474	20.7%	8.36	1.73
1965	1,946,157	17.9	2,464,980	94.3%	416,261	21.4%	8.45	1.81
1966	2,013,312	18.5	2,557,870	94.1%	445,261	22.1%	8.54	1.89
1967	2,083,992	19.1	2,658,330	94.0%	477,010	22.9%	8.63	1.98
1968	2,158,245	19.7	2,764,218	93.8%	511,295	23.7%	8.72	2.07
1969	2,235,864	20.4	2,877,389	93.7%	548,628	24.5%	8.81	2.16
1970	2,317,403	21.0	2,996,693	93.5%	588,981	25.4%	8.9	2.26
1971	2,402,141	21.9	3,119,827	93.4%	636,590	26.5%	8.99	2.38
1972	2,490,541	22.7	3,249,510	93.2%	687,955	27.6%	9.08	2.51
1973	2,581,709	23.5	3,383,556	93.1%	741,135	28.7%	9.17	2.63
1974	2,675,590	24.4	3,521,768	92.9%	797,483	29.8%	9.26	2.76
1975	2,771,577	25.2	3,660,944	92.8%	855,908	30.9%	9.35	2.89
1976	2,868,308	26.1	3,809,494	92.6%	920,132	32.1%	9.44	3.03
1977	2,967,209	26.9	3,961,276	92.5%	986,836	33.3%	9.53	3.17
1978	3,068,637	27.8	4,117,104	92.3%	1,056,313	34.4%	9.62	3.31
1979	3,172,940	28.6	4,277,783	92.2%	1,129,317	35.6%	9.71	3.46
1980	3,280,058	29.5	4,443,110	92.0%	1,205,239	36.7%	9.8	3.60
1981	3,388,229	30.4	4,608,436	91.9%	1,285,489	37.9%	9.89	3.75
1982	3,498,568	31.2	4,776,628	91.7%	1,368,224	39.1%	9.98	3.90
1983	3,611,804	32.1	4,949,439	91.6%	1,455,425	40.3%	10.07	4.06
1984	3,727,472	33.0	5,125,611	91.4%	1,545,085	41.5%	10.16	4.21
1985	3,846,493	33.8	5,304,875	91.3%	1,638,437	42.6%	10.25	4.37
1986	3,966,477	34.8	5,501,659	91.1%	1,742,070	43.9%	10.34	4.54
1987	4,088,315	35.7	5,701,181	91.0%	1,849,775	45.2%	10.43	4.72
1988	4,212,331	36.6	5,904,212	90.8%	1,961,466	46.6%	10.52	4.90
1989	4,337,698	37.5	6,108,507	90.7%	2,078,054	47.9%	10.61	5.08
1990	4,465,120	38.5	6,315,820	90.5%	2,201,098	49.3%	10.7	5.27
1991	4,657,352	39.5	6,587,682	90.4%	2,351,770	50.5%	10.79	5.45
1992	4,853,652	40.6	6,860,165	90.2%	2,509,271	51.7%	10.88	5.62
1993	5,053,141	41.6	7,134,183	90.1%	2,672,004	52.9%	10.97	5.80
1994	5,257,650	42.6	7,407,652	89.9%	2,838,797	54.0%	11.06	5.97
1995	5,465,944	43.6	7,680,485	89.8%	3,007,444	55.0%	11.15	6.13
1996	5,647,560	44.6	7,995,054	89.6%	3,197,941	56.6%	11.24	6.36
1997	5,824,421	45.7	8,296,921	89.5%	3,388,530	58.2%	11.33	6.59
1998	5,998,989	46.6	8,585,057	89.3%	3,576,049	59.6%	11.42	6.81
1999	6,167,442	47.6	8,857,427	89.2%	3,762,489	61.0%	11.51	7.02
2000	6,332,383	48.8	9,113,000	89.0%	3,957,071	62.5%	11.6	7.25
2001	6,504,772	50.0	9,383,000	88.9%	4,164,835	64.0%	11.69	7.48
2002	6,671,252	51.2	9,637,000	88.7%	4,372,606	65.5%	11.78	7.72

Estimating the Capital Stock: Sensitivity to Initial Capital and Depreciation

We followed a conventional approach in the literature in using the "perpetual inventory" estimates of capital stock based on accumulated gross capital formation (investment) adjusted for depreciation. Such estimates are sensitive to the assumptions employed.

We assumed that gross capital formation was available to facilitate production within the recorded year. Investments in upgrading agricultural land are typically made just prior to planting, so the benefit of the capital stock is enjoyed in the same year. Vehicles and machinery are similarly employed right away.

We assumed a depreciation rate of 10%. Others sometimes assume 6% or 8%. We argue for the 10% rate in this case on the grounds that capital investments made in a developing tropical agricultural country in general, and Cote d'Ivoire specifically, depreciate quickly. Tropical arable land will return to forest quickly if not rigorously maintained. Rural building of local construction similarly depreciates quickly, unless kept up. Machinery and vehicles are worked very hard and so also wear out quickly.

The basic algorithm used here was that current physical capital stock equals last year's capital stock less depreciation of 10%, plus this year's gross capital formation. Some analysts use the assumption that investment takes time to mobilize in production, and update last period's depreciated capital with last periods gross capital formation, when computing current period capital stock.

For presenting descriptive statistics we used data from SIMA/DDP database and worked in constant US dollars per capita, to facilitate reader's comparisons with the statistics of other countries outside the CFA zone. For Figure 10 and for Figure 11 in the main text above, we assumed an initial per worker capital stock of US$ 2,200 in 1995 dollars. For constant CFA, this amount was translated at 240 CFA per dollar. For the productivity regressions, as is common in the literature, we used constant local currency units under the argument that producers make their production choices based on local not world prices. (For CFA Franc countries the differences between dollar prices and local currency unit prices are not very large)

Next, we test the initial capital and depreciation rate assumptions in constant 1995 CFA Francs. Figure A-2 shows the profile of the capital stock assumption over time for the baseline, and then with an initial capital stock reduced by the CFA equivalent of $1,000, and then increased by $1,000. Varying initial capital stock by almost 50% has amazingly little impact on the time profile of capital stock over time, and no discernable impact after ten or twelve years. Part of this may be sue to the fact that the baseline assumes a 10% depreciation rate.

Figure A-2: Cote d'Ivoire - Sensitivity of Capital Stock Estimate to plus or minus $1,000 in Initial Capital Stock (in 1995 CFA equivalent)

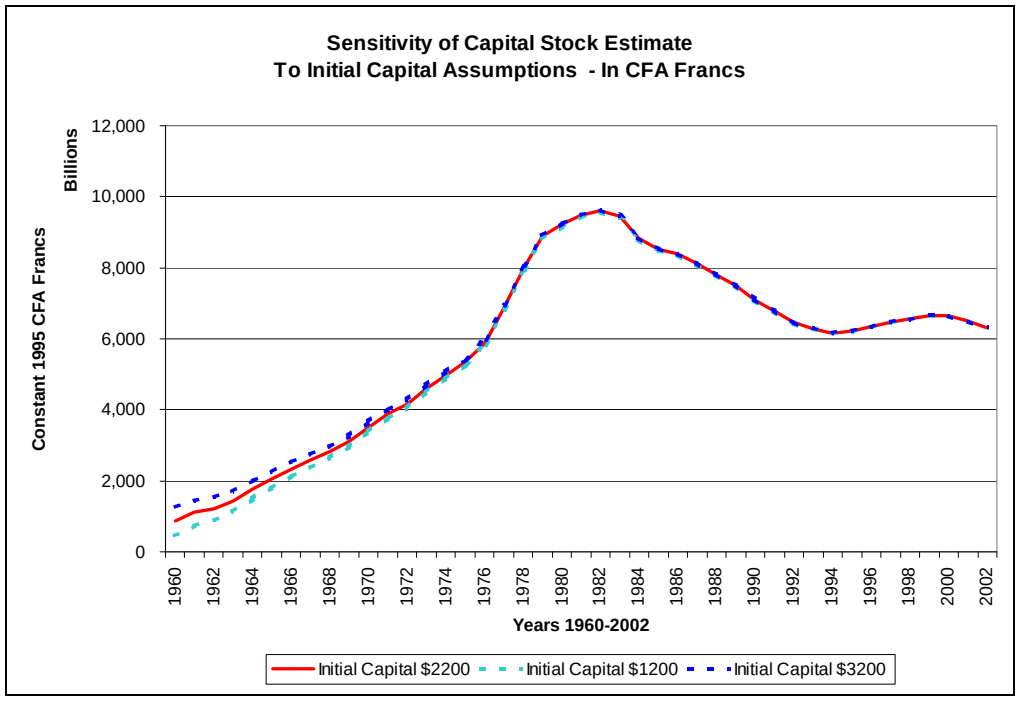
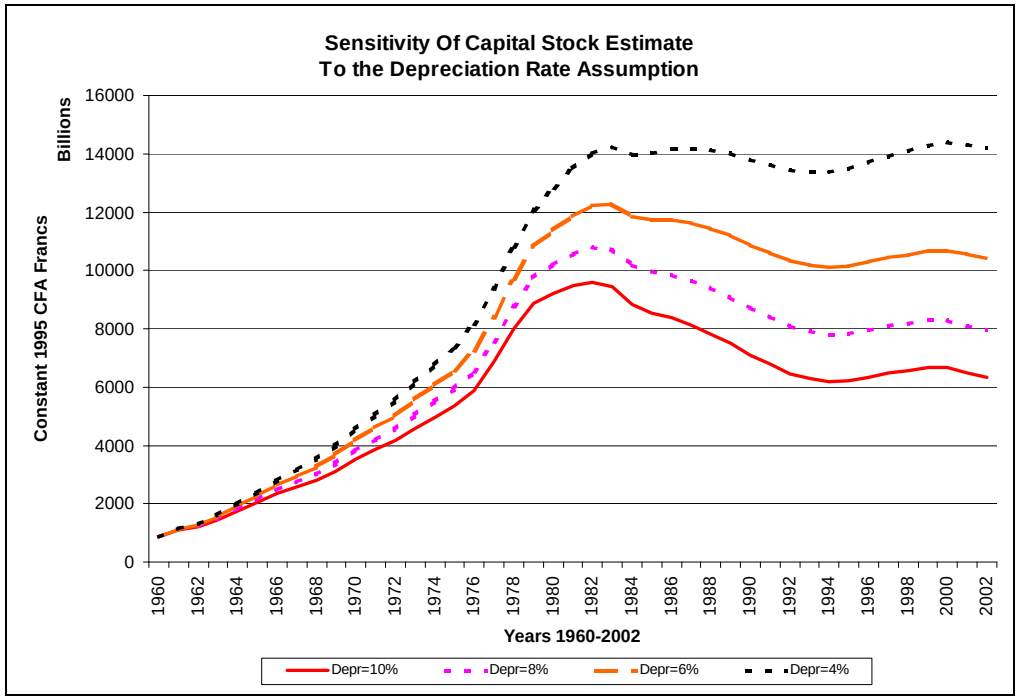


Figure A-3: Cote d'Ivoire – Sensitivity of Capital Stock Estimate to the Depreciation Rate Assumption – 4%, 6%, 8% and 10%



Next, we considered four different depreciation rates (Figure A-3). Here the difference in levels persists throughout the time series. In particular, the peak capital stock level in

1983 increases from CFAF 9.6 trillion (depreciation rate =10%) to CFAF 10.79 trillion (depreciation rate = 8%) to CFAF 12.38 trillion (6%) to CFAF 14.25 trillion (4%). The lower the depreciation rate, the longer capital "stays in the system," so the peak slides from 1982 (at 10%) to 1983 (at 6% or lower).

But, the time profile of capital stock remains remarkably similar for quite different depreciation rate assumptions. In particular, regardless of the depreciation rate used, gross capital stock in the economy flattens or decreases after the early 1980s. So, almost regardless of the depreciation rate chosen (within a wide range), the method generates the estimate that capital stock per worker began to decline after the early 1980s.

It appears that when using the "perpetual inventory" method of estimating capital stock, the main determinant of capital stock seem to be the investment flows, or gross capital formation. Initial capital stock and the depreciation rate, although important, are by comparison second-order determinants. This is reassuring as the perpetual inventory method is fairly robust in the presence of uncertainty about initial capital and depreciation.

Calculating TFP and Productivity Regressions

Calculating Total Factor Productivity

Conceptually, output is generated by a production function which uses as inputs factors of production: physical capital; human capital (which is the labor force adjusted for quality), and a host of other factors. Physical capital can be inferred from observed investment flows. Human capital can be estimated based on the labor force and educational attainment. The effect of all other factors, or total factor productivity (TFP), is commonly estimated as the "Solow-residual" when the factor shares for the contribution of physical and human capital are subtracted from output.

Starting with the familiar Cobb Douglas production function and assuming constant returns to scale, output Y in time period t is a function of capital K, labor L adjusted for quality by H, and all other factors in that time period, A. Variables are subscripted by t. The marginal return on physical capital, *a*, is assumed based on experience and other estimates to be 0.35, while the return on human capital is 0.65, for the world in general.[25]

1.	$\mathbf{Y = AK^{a}(LH)^{(1-a)}}$

Worker quality H is assumed to be a function of average schooling per worker, **s**. The rate of return to education in Africa has been estimated at 13%. Two functional forms are found in the literature:

2.a	$\mathbf{H = (1.13)^{s}}$

[25] See for example Bosworth & Collins (2003), Cohen & Soto (2001) or Gosh and Kraay (2001).

2.b	$\mathbf{H = e^{0.13s}}$

Suppose for the moment we choose the first form for average human capital, (2.a). Following numerous other authors, we divide through by the labor force to obtain an equation explaining per capita output (y = Y/L) as a function of physical capital stock per worker (k = K/L), average schooling per worker **s** over time, and TFP per worker (a = A/L). Taking the natural logarithm and differentiating with respect to time (or differencing for estimation purposes) we obtain:

3.	$dln\mathrm{y}/dt = dln\mathrm{a}/dt + \mathrm{a}dln\mathrm{k}/dt + (1\text{-a})\mathbf{s}ln(1.13)$

This functional form has the advantage that it is stated in growth rates, independent of units (currency units or manpower headcounts) and independent of conversion factors between capital, output, and labor. One then finds the rate of change in per capita TFP over time by re-arranging this equation, subtracting from the growth of output the share-weighted growth rates of capital per worker and the presumed growth in worker effectiveness as measured by average years schooling.

Comparison With Deterministic TFP Estimates by the World Bank

Sandeep Matajan (2003) has recently developed robust estimates of Solow-residual total factor productivity and the other related variable for numerous countries. These are found on the World Bank's intranet. These estimates are shown below, in Figure A-4.

To compare these estimates with those generated in this paper, Figure A-5 presents the Mahajan estimates in index form. These are readily comparable with the indices created for this paper found on Figure 10. The major difference is that this paper focuses on per worker productivity, capital, TFP, etc. To make the Mahajan estimates more comparable, one might subtract the difference of logs of the labor force (labor force growth) from Mahajan's capital stock growth rate and TFP growth, dragging down estimated TFP. In any event, the TFP indices created for this paper and the indices created from these World Bank sources have the same general profile.

The World Bank spreadsheet includes a summary for Cote d'Ivoire, presented in Figure 14 These also are not in per-worker form. They are quite like the estimates in this paper: output, physical capital and TFP grow strongly in the 1960s and 1970s, and weakly thereafter. In particular they grow more slowly than the labor force, so would be resoundingly negative (like ours) if put in per-worker terms. Human capital grows strongly throughout (like ours), as the labor force grows, and increases in quality.

Figure A-4: Estimates of Changes in TFP, Capital Stock and Human Capital (Mahajan, 2003)

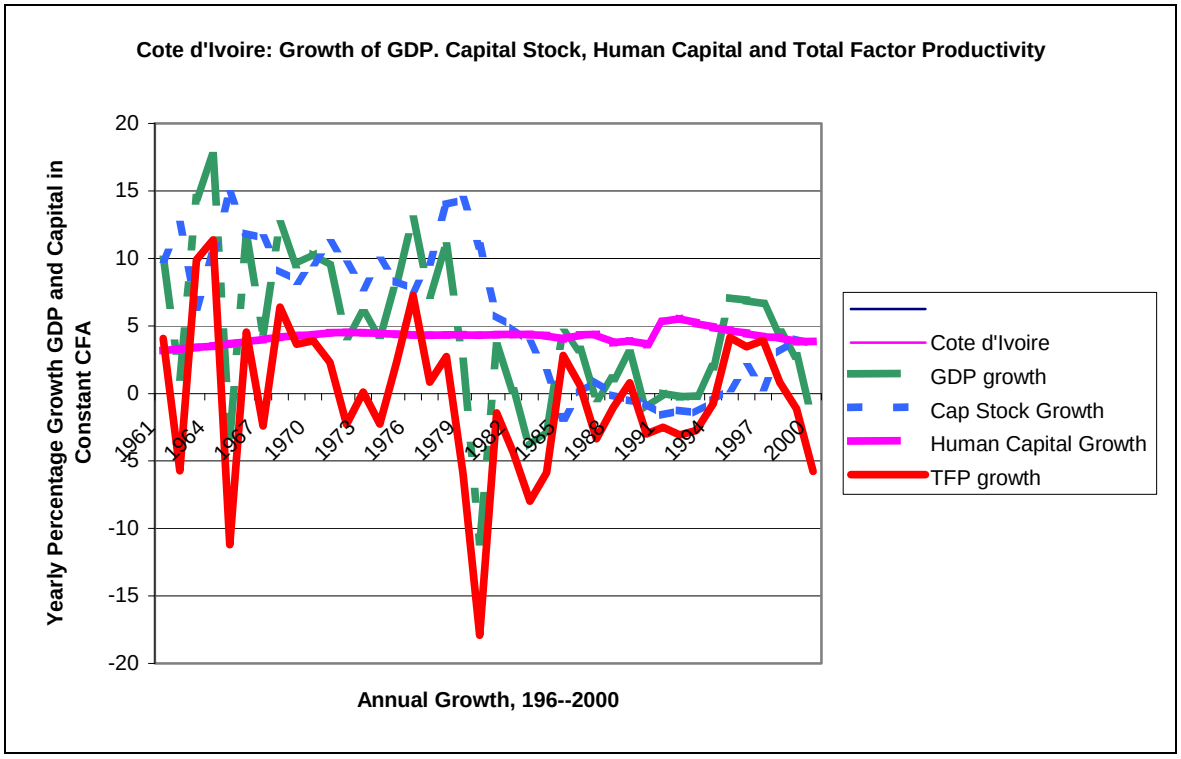
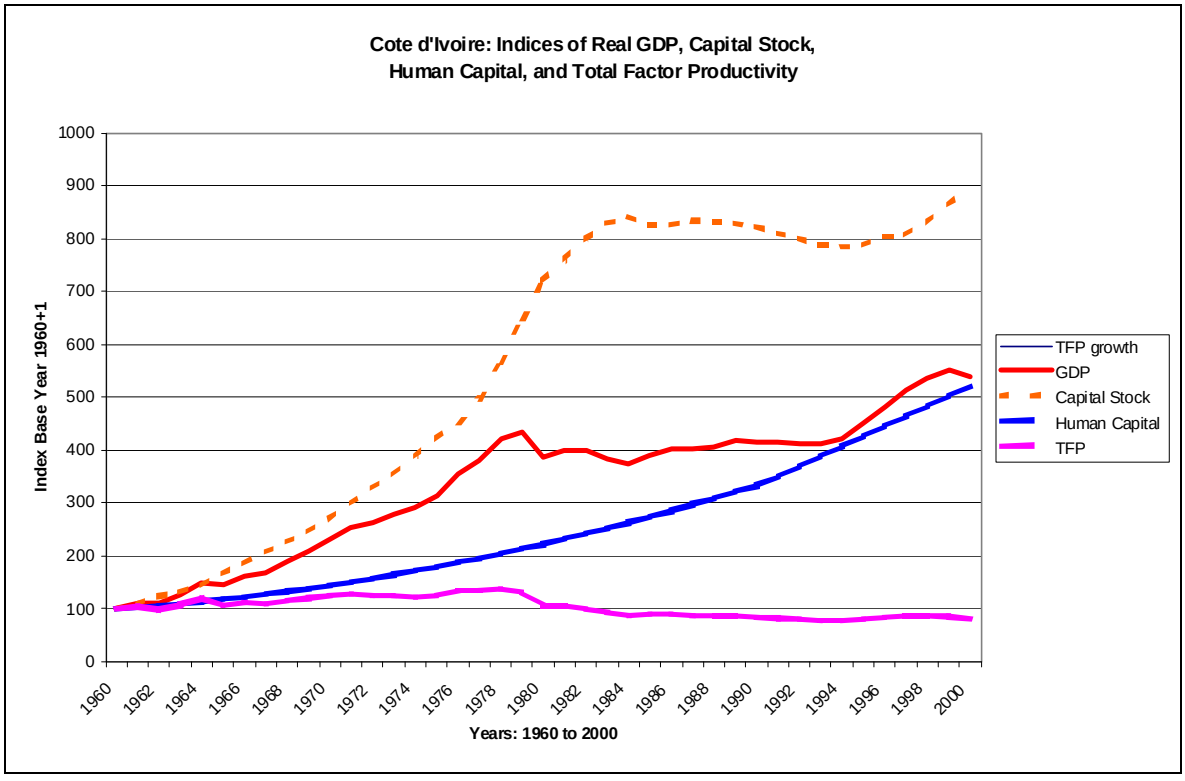


Figure A-5: Indices of TFP, Physical & Human Capital (Mahajan, 2003)



These two sets of estimates (in this paper versus those of Mahajan) were arrived at independently, and differ in assumptions and details of their calculations, and perhaps some differences in input data. Nevertheless, they present very similar profiles of the evolution of TFP and its components for Cote d'Ivoire.

Table A-2: TFP, Physical & Human Capital Growth (Mahajan, 2003)

Growth Rate Summary	1961-1970	1971-1980	1981-1990	1991-2000	1961-2000
GDP	8.71	7.61	-0.24	2.84	4.46
Capital Stock	10.54	10.22	2.55	0.43	5.76
Human Capital	3.70	4.39	4.20	4.58	4.22
TFP	2.28	0.89	-3.77	-0.09	-0.37

For Cote d'Ivoire. Source: Pradeep Mahajan, PRMEP, 2003, World Bank

Stochastic Regression Model of Factor Productivity

We now turn from a deterministic "accounting" model of factor productivity (which asserts parameter values) to a stochastic regression model of factor productivity (which estimates parameter values). By fitting such a model, we can verify to some extent the validity of the analysis in the last section. We will use the capital and labor-quality variables developed for the deterministic calculations, and test them in an econometric model.[26]

We performed standard Augmented Dickey-Fuller (ADF) Tests (assuming no constant or trend in the ADF test equation) on the natural logarithms (logs) of the variables we used: real output per worker and estimated capital stock per worker (in constant local currency, CFA franc), schooling per worker, and the index of terms of trade (normalized to unity). As expected, there existed unit roots in the levels, but all variables were integrated of order one (stationary in the first differences). The ADF Z(t) statistic was less than 5% critical value in all cases, usually less than 1%. So, our point of departure is to estimate the regressions in the first differences (an error-correction model exists for the levels). Since these are logged variables (except for average schooling), the first differences are the estimates of the growth rates.

The results were satisfactory, especially when on considers that the sample is small, the main explanatory variables were estimates we constructed, and that many analysts have experienced major difficulties with data from Sub-Saharan Africa.[27] Furthermore, there is presumably a whole host of other omitted factors (variables) "explaining" productivity, such as policy, warfare, institutional factors, politics, the environment, and so forth.

[26] See Bosworth & Collins (2003), Cohen & Sots (2001), and Ghosh & Kraay (2000)

[27] For example, Bosworth and Collins did not extend their global TFP estimates to Africa in their paper "The Empirics of Growth: An Update", September 22, 2003.

A point of departure is simple, univariate, ordinary least squares (OLS) model of growth of output per worker as a function of the growth of capital stock per worker (A-3).

Table A-3: Output growth as a Function of Capital Accumulation

Dependent Variable: First Differences of Logs of Real Output per Worker		
Indépendant Variable	Coefficient	T-Statistic
Delta Log, Capital per Worker	0.52967	5.36
Constant	0.00282	0.43
Durbin-Watson d-Statistic: 1.859 R-Squared: 0.42 F(1,40) = 28.7 ADF test on residual: Z(t) = -5.818 > 1% Critical Value		
Define: Coefficient on average capital/worker = b_1 Test: b = .35 F(1,40) = 3.30 Prob > F = 0 .0767		

This univariate OLS regression seems surprisingly robust. The residuals are reasonably well-behaved, and the capital coefficient estimate is of plausible magnitude with the correct sign and a small standard error, hence yielding a "good" T-statistic. This one variable "explains" a considerable part of the dependent variable. We conduct a test of whether the coefficient estimate equals the "standard" of 0.35 and reject the hypothesis, accepting the alternative hypothesis that it is higher than 0.35. Capital stock per worker is a major determinant of productivity in Cote d'Ivoire.

Consider next a bivariate "factor" model of productivity, which adds a term for human capital to the univariate regression above, in this case the first differences of our estimate of average schooling per worker. The schooling coefficient point estimate comes in at $\mathbf{b_2}$ = 0.0553, not far from the "ballpark" expected value of 0.079 (which we would revise downward anyway if we accept the proposition that Cote d'Ivoire has a high MPK and hence $\mathbf{a}$ > 0.35). However, the coefficient estimate has a wide confidence interval and low T. It seems that our estimate of human capital is imprecise, but of some utility.

Total Factor Productivity in a deterministic framework is a residual, that share of output that is not attributed to quality-adjusted labor (human capital) or physical capital. The concept of "Solow-residual" TFP is not directly observable; there is no times series of direct observations to rely upon. For the regression analysis, analysts have traditionally used proxy variables or instrumental variables, ranging from the urbanization rate or population, to trend variables, and so forth. But, in Cote d'Ivoire specifically and (and in some other developing countries[28] TFP growth over time is not a simple quasi-linear trend; it grew in the 1960s and 1970s and plunged thereafter. Proxies or instruments must be carefully selected.

[28] See for example Bosworth and Collins (2003).

We noted during the analysis that the TPF measured in the last section by accounting methods had a time profile rather similar to the time profile of the terms of trade. Recall, the terms of trade rose in the early years as the price index of Cote d'Ivoire's exports rose above the price index for its imports; later the reverse occurred. From an empirical point of view, terms of trade seemed a good proxy or instrument for TFP.

From a conceptual perspective, much of Cote d'Ivoire's output is sold abroad, while many physical capital and other production inputs are purchased from abroad. So, if world prices for commodity exports increases, the extra value added contributes to the "residual", TFP. If prices of imported production inputs increase, the residual value added is reduced. That is, for a small trading economy, the terms of trade impact the value added of economic production. In a sense, we are simply inserting relative world prices into the equations of the Cobb-Douglas production function considered earlier. If Cote d'Ivoire is a price taker on world markets, these prices are exogenous.

Table A-4 presents the coefficient estimates and measures of "goodness of fit" for a regression "explaining" the rate of growth of output per worker as a result of the growth rate of physical capital per worker, the increase of average schooling per worker (representing growth in human capital), and the rate of change of the terms of trade. The rate of change of the terms of trade is taken as an important determinant of or proxy for Total Factor Productivity.

Table A-4: Cobb-Douglas Regression Estimation Results of a Factor Productivity Model for the Cote d'Ivoire, 1960-2002

Dependent Variable: First Differences of Logs of Real Output per Worker

Indépendant Variables	Coefficient	T-Statistic
Delta Log, Capital per Worker	0.56473	4.31
Delta, Average Schooling per Worker	0.05528	0.32
Delta Log Terms of Trade	0.10019	2.77
Constant	- 0.00465	0,17

Durbin-Watson Statistic: 1.9607 R-Squared: 0.52 F(5,36) = 13.5
ADF test on residual: Z(t) = -6.153 > 1% Critical Value

The coefficient point estimates for the contributions of physical capital and human capital (schooling) differ somewhat from the values often assumed in the literature, and from those which were assumed in the accounting TPF estimate presented earlier, but not enough to warrant recalculating TFP. A one percent change in the rate of change in terms of trade results in a one-tenth of a percent change in the measured value of per capita output.

More polished versions of this model might be obtained with further effort. The results seem to generally validate the TFP accounting estimates, which showed a decline in TFP in recent years in Cote d'Ivoire, rather than growth. The results also suggest that for

small open trading countries like Cote d'Ivoire, the terms of trade are important explanatory factors for economic productivity and output growth.

We experimented, substituting the literacy rate for our schooling measure. The coefficient point estimate was large and negative, albeit with a rather large confidence interval and low t-statistic. We conclude that however imprecise our schooling measure may be, especially as a measure of worker quality, it is better than the literacy rate, and better than leaving it out.

The civil war reduced growth. We also found that a dummy variable for the war in 2000-2002 had a coefficient of the right sign and plausible magnitude, with a t-statistic of 1.21[29]. Our best estimate is that the occurrence of the minor conflicts of 2000-2002 knocked 3.8% off the expected growth rates for those three years, for a cumulative effect of 11% for the three years.[30] This is a very conservative estimate on at least two considerations. One, it does not take into account the indirect effect on growth via reduced capital investment due to fear of war; capital stock is simply taken as given in this model. Two, the turmoil in 2000-02 mild compared with the civil war that broke out in September 2002.

[29] The coefficient point estimate was -.03765 with a standard deviation of 0.03123
[30] (1 – 03765) raised to the power of three approximately equals 0.8912.

Deriving Specific Hypotheses for Expected Parameter Values

Theoretically, the functional form of our productivity model is given by the usual Cobb-Douglas production function, where output is a function of physical capital, quality adjusted labor, and other explanatory variables **X**.

$$\mathbf{Y = C(t)K^{a}L^{*(1-a)}X^{B}}e^{\mathbf{BX}}$$

There are two candidate functional forms for **L*** which are approximately equivalent:

$$\mathbf{L^* = L \times H(1) = L(1 + r)^{S}} \quad \text{or} \quad \mathbf{L^* = L \times H(2) = L}e^{\mathbf{rs}}$$

We divide through by **L** to put the equation in output and capital per worker form, denoted with lower case letters. We take natural logarithms to make the equation linear and additive, and then differentiate with respect to time to put the equation into growth rates. This gives us our Population Regression Function (PRF):

$$\mathbf{(PRF)}\ dln\mathbf{y}/dt = dln\mathbf{c(t)}/dt + \mathbf{a}dln\mathbf{k}/dt + \mathbf{(1-a)}ln\mathbf{(1+r)}d\mathbf{s}/dt + \mathbf{B_1}ln\mathbf{X'_1} + \mathbf{B_2X'_2}$$

The point is that depending on the functional form assumed for **H**, the rate of return to education **r** or $ln(1+\mathbf{r})$ is associated with the labor factor share $(1 - \mathbf{a})$ and the first differences of the variable **s**, the average years schooling per worker. The Sample Regression Function (SRF) that we estimate is:

$$\mathbf{(SRF)}\ \ dln\mathbf{y}/dt = \mathbf{c} + \mathbf{b_1}dln\mathbf{k}/dt + \mathbf{b_2}d\mathbf{s}/dt + \mathbf{B_1}ln\mathbf{X'_1} + \mathbf{B_2X'_2}$$

Suppose for a moment, as is commonly assumed, that the exponent associated with physical capital is 0.35, so that the coefficient associated with human capital or quality adjusted labor is 0.65. Suppose also that the rate of return to education (**RRE**) in Africa is high, at 13%. Then we can assign "ballpark" numeric values to the expected values of our sample regression parameter estimates for $\mathbf{b_1}$ and $\mathbf{b_2}$, under the hypothesis that our PRF and SRF set-up is correct, as follows:

$$\boldsymbol{E}\{\mathbf{b_1}\} = \textit{Capital Contribution} = \mathbf{a} = \mathbf{0.65}$$

$$\boldsymbol{E}\{\mathbf{b_2}\} = \textit{Labor Contribution} \times \mathbf{RRE}$$

$$= \mathbf{(1 - a)}ln\mathbf{(1 + r)} = \mathbf{(0.65) \times} ln\mathbf{(1.13)} = \mathbf{0.0794}$$

Alternately, one may substitute (0.65) x (0.13) above. (Note that the assumption a = 0.35 is considered appropriate for the world economy in general, which dominated by developed countries.) Furthermore, care may be taken that other explanatory variables are entered either in logarithmic or linear form, as appropriate.

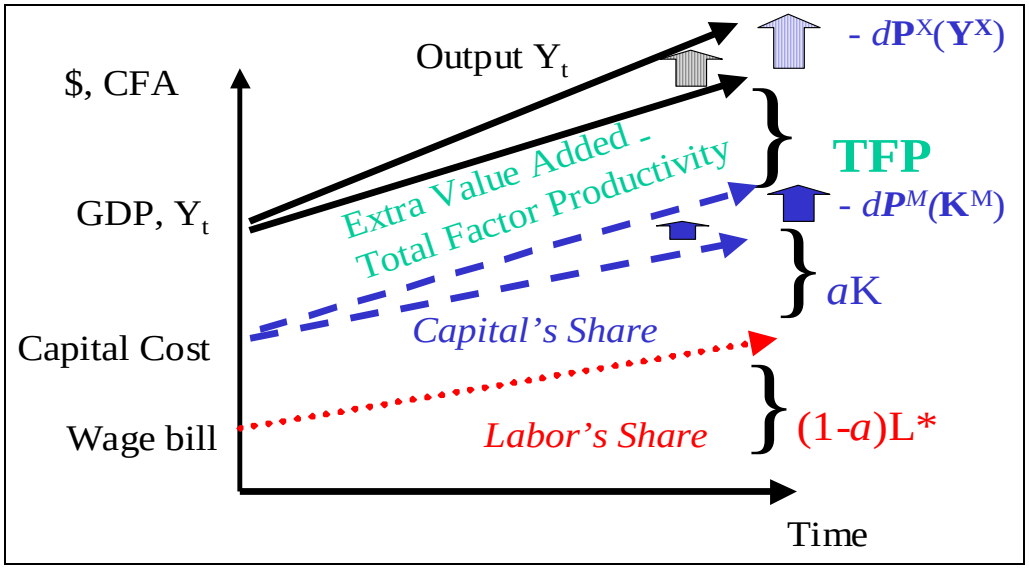
Productivity Regression Data

LNTERMS	lnYL	lnKL	lnIL	war
0.195597075	13.56567206	13.50273294	11.89418359	0
0.01213893	13.63036667	13.62127714	12.12622101	0
0.021042458	13.61172432	13.64749306	11.74977866	0
0.151887531	13.71530307	13.72974085	12.10498303	0
0.25689101	13.84523414	13.8664145	12.43896993	0
0.029280476	13.78023699	13.95758233	12.3748589	0
0.029616206	13.85586063	14.04091473	12.42936888	0
0.029838754	13.86631216	14.09152501	12.33956417	0
0.029626057	13.94951388	14.13135339	12.32891306	0
0.189000861	14.00529411	14.18982621	12.47827683	0
0.251450053	14.06818833	14.2661494	12.63382669	0
-0.101907909	14.12263346	14.32056897	12.59311052	0
-0.17044778	14.12798729	14.35260476	12.5157202	0
-0.029818544	14.14973089	14.41213075	12.70813534	0
-0.000169234	14.15637593	14.45174492	12.65180422	0
-0.157882317	14.20042949	14.48416046	12.64456177	0
0.096952618	14.28760116	14.54573116	12.84352773	0
0.429270084	14.32429473	14.66200971	13.17257834	0
0.325652654	14.39422697	14.77892189	13.29067691	0
0.210898166	14.38446377	14.84979958	13.18454659	0
-0.329401347	14.23520265	14.85368109	12.8345015	0
-0.406058584	14.23716263	14.84849998	12.76269524	0
-0.440588359	14.20712239	14.82894764	12.63229558	0
-0.39604346	14.13548553	14.77965293	12.30467933	0
-0.20695394	14.07657855	14.67993138	11.36893371	0
-0.108144709	14.08917538	14.61392576	11.93065665	0
-0.090770041	14.09053262	14.56639144	12.09817457	0
-0.275403535	14.05678211	14.502942	11.83828643	0
-0.359202156	14.03819959	14.43531628	11.70781768	0
-0.530332274	14.03792584	14.36600448	11.6058994	0
-0.671972802	13.99795397	14.2813417	11.25386316	0
-0.594356155	13.95621218	14.19273022	11.33151038	0
-0.54704525	13.91247921	14.10299895	11.20845635	0
-0.452924182	13.87027389	14.03586067	11.45222126	0
0.012437816	13.8386791	13.97704984	11.4834388	0
0	13.86865956	13.94677499	11.71824886	0
-0.024464384	13.91042456	13.93213469	11.77879731	0
-0.035204369	13.93521491	13.92236837	11.79175492	0
-0.038491072	13.95210215	13.90524995	11.70794878	0
-0.023978592	13.94013457	13.8942581	11.73062068	0
-0.194188598	13.88870187	13.86642245	11.55075334	1
-0.204096314	13.86531137	13.81455389	11.25330228	1
-0.209580099	13.82169785	13.76282549	11.18410469	1

How Terms of Trade Impact TFP

Here we first present an intuitive explanation of why the terms of trade impact measured Total Factor Productivity in a trading nation like Cote d'Ivoire which imports capital goods and production inputs, and then sells part of its output abroad.We have observations of the value of GDP or output. We calculate an estimate of the output contribution of quality adjusted labor, and then the output contribution of physical capital stock. The residual or difference is not attributable to capital or labor is "total factor productivity" or TFP.

Figure A-6: Total Factor Productivity and Changes in the Terms of Trade



Y_t, equals output quantities times output prices, and includes the share of output exported abroad at export prices, $P_t^x Q_t^x$, as well as the share of output consumed domestically $P_t^d Q_t^d$. If the price of exports (P) goes up, the value of exported physical output (Q) goes up, and consequently the value of GDP (Y) goes up even if physical quantity volumes are held constant. This causes calculated TFP to go up. That is, if the terms of trade improve due to an increase in the prices for exports, the value added in production goes up in a manner not attributable to the two factors of production, physical labor or human capital (labor), so the "residual" estimated TFP goes up. If prices of exports on the world market goes up (or down), the terms of trade improve, and the value of an exporter's GDP goes up (or down).

To produce GDP, investments are made in the physical capital stock and factor inputs, such as vehicles and machinery and fuel, some of which is imported. Consider a deterioration in the terms of trade caused by an increase in the price level of imported capital goods. If the price level of those imported capital items required for production goes up, the estimated share of total output or GDP attributable to capital goes up. All else equal, if GDP is held constant, the calculated TFP goes down when the terms of

trade deteriorates due to increases in the price level of imported capital and inputs (and vice versa).

More formally, in the "Solow Residual" framework, total factor productivity is defined as:

TFP $\equiv$ GNP - (contribution of capital) – (contribution of labor)

$$TFP = Y - aK - (1-a)L^*$$

Or, TFP equals the value of units of output less the marginal product of capital times the value of capital and less the marginal product of labor time quality-adjusted labor:

$$TFP = PQ - MPK(P^kK) - MPL(L^*)$$

Decompose output into the value of exports plus the value of output consumed domestically, and decompose capital into the value of capital imported from abroad plus the value of domestically produced capital:

$$TFP = (P^xQ^x + P^cQ^c) - r(P^mK^m + P^dK^d) - wL^*$$

This definition of TFP holds as an identify. If we differentiate this identity with respect to the price level of exports, we obtain a positive derivative:

$$dTPF/dP^x > 0$$

Similarly, if we differentiate with respect to the price level of imports applied to capital, we obtain a negative derivative:

$$dTPF/dP^M < 0$$

Hence for a trading exporting nation which is a price-taker on world markets and imports capital goods and production inputs, we expect fluctuations in the terms of trade (incorporating the ratio of the price levels of imports and exports) to impact Solow-residual TFP so defined in the manner described here. For such nations, we might expect the terms of trade index (or alternately the price levels of imports and for exports) to be a good proxy for TFP in Cobb-Douglas-style productivity regression models.

There is literature on how the terms of trade affect macroeconomic performance. Analysts at the IMF have studied how commodity price "shocks" impact economies[31]. The literature seems to focus on the impact on exchange rates, and the real exchange rate, rather than productivity or Solow-residual-TFPs *per se*. Here, we provide evidence that commodity price innovations may directly impact measured productivity. It seems very reasonable that the measured output growth of a commodity exporting nation may be impacted by external price shocks, or price trends, in a manner independent of factor

[31] See for example Cashin (2003), Cashin et al (2003), Chen and Rogoff (2002).

employment within the country, This literature notes that commodity price time series are characterized by small downward long-term trends and a great deal of volatility. Some 44 developing nations depend on four commodity exports or less[32].

[32] Ibid.

ANNEX TWO: Some Comparisons of Cote d'Ivoire's Growth Record

Cross Country Comparisons

How did Cote d'Ivoire's growth compare with that of other developing countries? This section compares recent per capita real growth in GDP[33] for several peer groups of countries versus Cote d'Ivoire for the most recent, ten year period 1993 to 2002, and the ten-year average. First, we compare Cote d'Ivoire to other African and poor countries. Then we more on to compare her with other CFA countries, and other countries in Africa experiencing conflict. Cote d'Ivoire grew more slowly than any of these benchmark peer groups.

Other Developing Countries

Summary benchmarks and comparisons:

- ***Sub-Saharan Africa*** (48 countries) The Sub-Saharan Countries as a group averaged 2.90% growth over the decade, more than half a percent more than Cote d'Ivoire.[34]
- ***West Africa*** (23 countries) Cote D'Ivoire ranked 18th in this group for the decade. West Africa grew at a 4.6% average annual rate for the decade, more than 2.2% faster than Cote d'Ivoire
- ***Poor Countries*** (63 countries with 2002 per capita GDI less than $735) Measured by average growth over the decade of 1993-2002, Cote d'Ivoire ranked 39th out of the 61 poor countries for which statistics are available. The poor countries as a group averaged 3.52% growth for the decade versus 2.36% for Cote d'Ivoire.

Figure A-7 shows plots West African average annual growth against that of Cote d'Ivoire. Both Cote d'Ivoire and West Africa emerged from a slump in 1993 to grow strongly in the post-devaluation period. This is in part due to the fact that many West African countries are CFA countries, which suffered together from currency over-valuation until 1994, and then benefited from the large and long-awaited devaluation in January 1994. But West Africa as a whole posted even stronger growth in 1997, while Cote d'Ivoire experienced a downturn. From 1998 to 2002, West Africa grew at about 5% while Cote d'Ivoire did not grow at all, posting negative growth in 2000 and 2002. While West Africa as a whole turned around in the mid 1990s and began to grow again, Cote d'Ivoire experienced an ephemeral upturn and slipped back into decline.

[33] From SIMA, in constant 1995 US dollars.
[34] There are simple arithmetic averages of reported growth rates; they are not weighted by population.

Figure A-7: Comparison of Growth in Cote d'Ivoire to West Africa

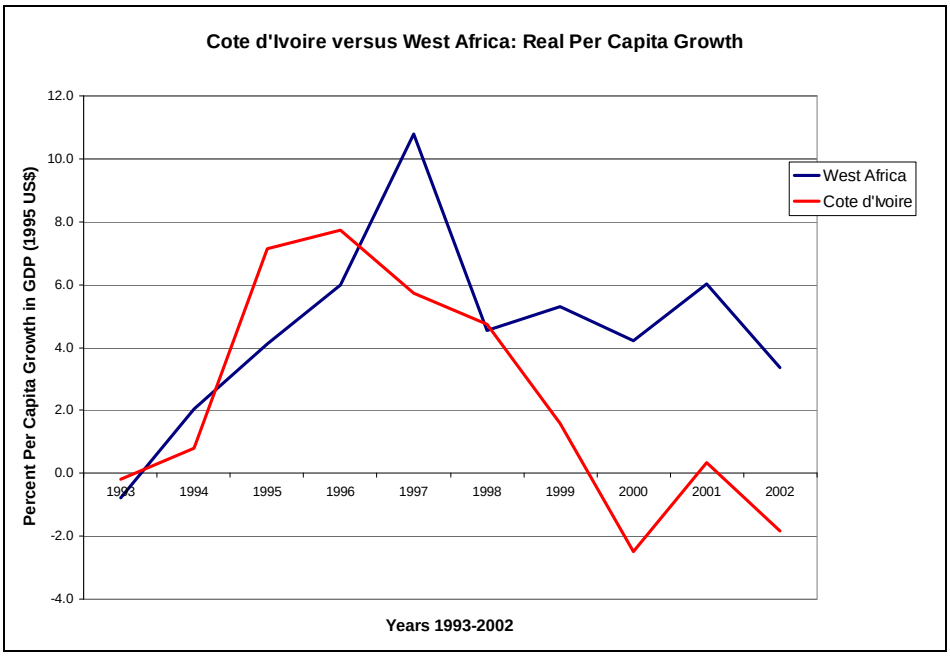
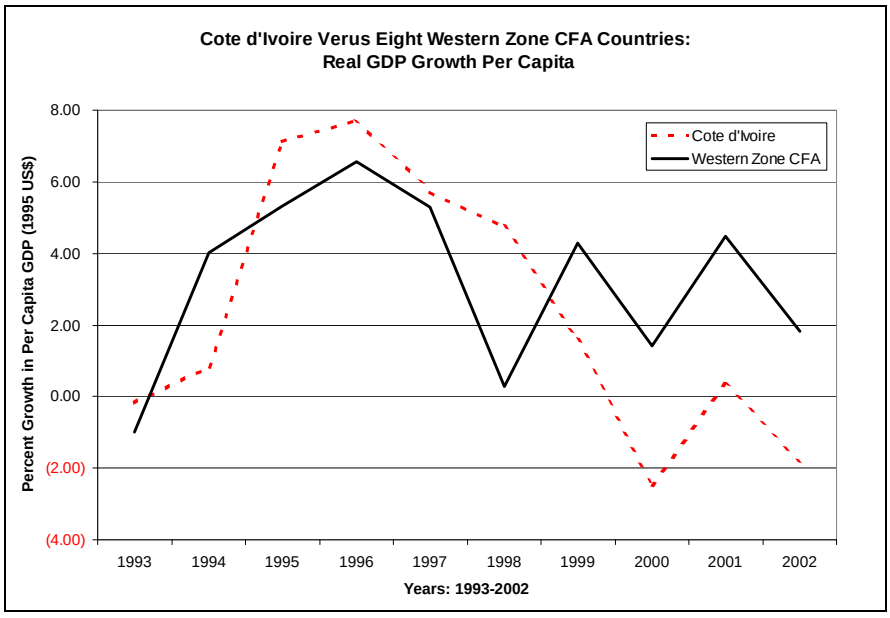


Figure A-8: Comparison of Growth in Cote d'Ivoire to West Zone CFA Countries



Western CFA Franc Zone: One narrower peer group for comparison is the eight countries that share the CFA Franc in the CFA Western zone. They share to some extent culture, regional ties, and colonial heritage[35], as well as sharing a currency. The Banque Central des Etats d l'Afrique de l'Ouest (BCEAO) acts as a common central bank for the

[35] Except for Guinea Bissau, a former Portuguese colony.

West African Economic and Monetary Union. Figure A-8 shows a graph of annual per capita growth in real output for Cote d'Ivoire, as well as the arithmetic average for the western eight CFA countries which share the CFA franc. Table 6 provides the same information in greater detail, showing the per capita growth rates for each country.

Looking at the graph, we see that Cote d'Ivoire tracks the average of the eight western CFA countries, moving more or less in line with them all, but has lower growth on average than the group. The west CFA group responded to the December 1994 devaluation of the CFA with strong growth, which continued for a few years and then died out. Looking at Table A-5 reveals considerable variation.

Table A-5: Per Capita Real Growth Rates in CFA West Zone Countries, 1993-2002

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Averag
Benin	3.52	4.37	4.60	5.55	6.15	4.54	4.70	5.76	5.02	6.01	5.02
Mali	(2.14)	0.91	6.21	3.22	6.76	6.03	6.73	(3.35)	13.29	4.37	4.20
Burkina Faso	4.60	1.00	4.60	7.10	5.20	1.00	6.70	1.60	4.60	4.60	4.10
Senegal	(2.22)	2.87	5.17	5.14	5.04	5.74	5.00	5.58	5.57	1.10	3.90
Niger	1.45	4.00	2.61	3.42	2.75	10.42	(0.57)	(1.41)	7.10	2.98	3.28
Cote d'Ivoire	(0.19)	0.81	7.13	7.73	5.72	4.75	1.58	(2.47)	0.35	(1.82)	2.36
Togo	(15.10)	14.98	7.85	8.84	4.25	(2.10)	2.38	(1.91)	(0.21)	4.61	2.36
Guinea-Bissau	2.10	3.20	4.40	11.60	6.50	(28.10)	7.80	7.50	0.20	(7.20)	0.80
BCEAO Average	(1.00)	4.02	5.32	6.57	5.30	0.29	4.29	1.41	4.49	1.83	3.25

Cote d'Ivoire is a relatively weak performer within this group, averaging 2.36% average annual growth per capita versus 3.25% for the group. Benin, Burkina Faso, Senegal, Mali and Niger all grew faster than the Cote d'Ivoire. Only Guinea-Bissau grew more slowly. The fact that Cote d'Ivoire posts slower growth than other nearby CFA countries suggests that the currency arrangements and exchange rate issues have not been the only causes of Cote d'Ivoire's slow growth. Most other nearby countries with the same currency managed to grow faster in the last decade.

African Countries in Conflict: Civil strife and war are prevalent in Sub-Saharan Africa, providing yet another benchmark for comparison. Table A-6 provides real per capita GDP growth rates for eleven Sub Saharan countries, which experienced either civil war or war with a neighboring country during the 1992-2002 period. These conflicts range in scale, intensity, duration and timing.

These results may be skewed by the inclusion of Liberia, which experienced strong growth in the mid 1990s as the country began to recover from it's brutal civil war. Cote d'Ivoire performed below the average in this sample, ranking below the mid point, based on the ten-year average. Liberia, Ethiopia, Eritrea, Sudan, Rwanda and Angola all averaged faster growth over the decade. Cote d'Ivoire outperformed Congo (Brazzaville), Sierra Leone, Burundi and Congo (Kinshasa).

Table A-6: Real GDP Growth Per Capita, Selected African States Experiencing Conflict, 1993-2002

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Average
Liberia	(32.98)	(21.76)	(4.27)	12.12	106.28	29.70	22.90	20.40	4.90	3.30	14.06
Ethiopia	13.36	3.49	6.12	10.91	5.38	(1.86)	6.20	5.74	8.88	2.72	6.09
Eritrea	13.37	21.22	2.86	9.25	7.90	1.78	(0.01)	(13.15)	10.22	1.81	5.53
Sudan	4.57	1.01	6.00	5.92	6.34	6.44	6.46	5.14	6.10	5.52	5.35
Rwanda	(8.11)	(50.25)	35.22	12.75	13.85	8.86	7.58	5.97	6.72	9.38	4.20
Angola	(24.70)	3.50	10.40	11.20	7.90	6.80	3.35	3.04	3.17	15.30	4.00
Cote d'Ivoire	(0.19)	0.81	7.13	7.73	5.72	4.75	1.58	(2.47)	0.35	(1.82)	2.36
Congo, Rep.	(1.00)	(5.50)	5.00	4.30	(0.60)	3.70	(3.00)	8.20	3.60	3.50	1.82
Sierra Leone	1.38	(1.95)	(8.00)	6.09	(17.60)	(0.88)	(8.08)	3.81	5.40	6.30	(1.35)
Burundi	(5.71)	(3.86)	(7.27)	(8.36)	0.37	4.78	(0.97)	(0.90)	3.20	3.60	(1.51)
Congo, Dem	(13.47)	(3.90)	0.70	(1.02)	(5.62)	(1.62)	(4.40)	(7.00)	(2.00)	3.00	(3.53)
Average	**(4.86)**	**(5.20)**	**4.90**	**6.44**	**11.81**	**5.68**	**9.25**	**2.62**	**4.59**	**4.78**	**3.36**

Peace may bring opportunity to advance. Countries that resolve their conflicts, or at least end or mitigate them, often grow strongly in subsequent years. There are numerous examples, including Liberia and Sudan and Rwanda recently, and Uganda in earlier years. There can be a distinct "bounce-back" effect; countries resolving their conflicts often recover by growing rapidly for a period of several years, albeit from a lowered base. If Cote d'Ivoire can resolve it's difficulties, the result may be growth.

Many of these African countries experienced very severe conflict, and still managed to grow faster than Cote d'Ivoire. That simple fact may suggest that the recent conflict is not the sole or single major cause of Cote d'Ivoire's slow growth, which after all has persisted now for more than two decades.

According to statistics released by the Center for Systematic Peace, the civil war in Cote d'Ivoire started in 2000 and as of 2002 was still continuing, with about 2,500 "directly related" deaths[36]. They list it as a low-intensity conflict, with a new outbreak in 2002, with "conflict magnitude" or severity rated as only "2" on a scale of 1 to 10[37]. This is a rather small conflict by African standards. In nearby smaller Guinea-Bissau 6,000 died in the 1998-99 coup and civil war. Some 100,000 Eritreans died in the 1998-2000 war with Ethiopia. More than 1.5 million died in Congo (Zaire) between 1996 and 2002. Some 500,000 died in little Rwanda in 1994 alone. Civil war claimed 25,000 in Sierra Leone between 1991 and 2001.Over a million have died in the last twenty years in Sudan. So, things could easily get much worse in Cote d'Ivoire if the conflict is not resolved. The outbreak of civil war in 2003 has not yet been rated in terms of "magnitude", but is presumably much worse than the earlier conflict.

[36] See the website maintained by M. Marshall, 2003.
[37] See also Marshall & Gurr, 2003.

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